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METALLURGICAL PROJECT

A. H. Compton - Project Director
R. S. Stone, M.D. - Associated Project Director for Health

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CLINTON LABORATORIES

M. D. Whitaker - Director
R. L. Doan - Associate Director for Research

* * *

HEALTH DIVISION

S. T. Cantril, M. D. - Director

HEALTH- PHYSICS SECTION OF HEALTH DIVISION

K. Z. Morgan - Section Chief

* * *

BIOLOGY SECTION OF RESEARCH DIVISION

H. J. Curtis - Section Chief

* * *

REPORT FOR MONTH ENDING JULY 29, 1944

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CLINTON LABORATORIES

HEALTH DIVISION
and
BIOLOGICAL SECTION OF RESEARCH DIVISION

ABSTRACTS

I. Medical Section

The routine medical activities continue on about the same level as before. The number of sub-major injuries increased.

The special hazards connected with alpha emitters occupied considerable attention in connection with the opening of a new laboratory for work with this material.

In the Haematological Group, stippled red cells are still being found, but no explanation for the occurrence has been determined. a considerable number of low white counts has been found, but the percentage of those found in the work hazards group is not significantly greater than that found in the control group.

II. Health-Physics Section

The pocket meters show a 30% improvement due to heating the desiccant caps. Grinding the old clips off the pocket meters has not injured them.

On the average there is very good agreement between the high badge meter readings and the corresponding pocket meter readings.

The Parker 4-fold hand counter is an outstanding improvement over the old type. (Special report in preparation).

Several hot hats have turned up. Men working in Cells will be furnished washable caps.

Laundry decontamination efficiency is greatly increased by overnight soaking.

Photographs of the experimental holes in the pile reveal defects in the grouted section.

Water sampling procedures are being simplified.

Some of the lead bricks which had been exposed to neutrons were found to be highly active due to the presence of radio antimony.

The relative value of gloves as radiation absorbers is indicated.

III. Biological Section

A carriage for exposing mice to slow neutrons in the tunnels has now been finished and tested, and exposures will start in a few days. A number of new series of chronic exposures to fast neutrons have been started, and many more are planned.

The remote control ether extractor has been tested with a hot solution and found to work quite well. An adsorption column was constructed in the hot laboratory and tested on the super-juice from the extractor. Zr was separated by this method, and it is anticipated that others now being processed will separate as well.

More careful work has confirmed the observation that rather high concentrations of fission products are found in the lung and liver, as well as the skeleton, for at least 9 days following an exposure to air-born fission products.

CLINTON LABORATORIES

I. MEDICAL SECTION OF HEALTH DIVISION

Report by P. A. Fuqua, M.D.

1. Medical Activities

(a) Pre-employment physical examinations now approximate the number of termination examinations. It was necessary to reject for employment three applicants due to major physical disabilities.

(b) Dispensary service continued on a 24 hour basis, with a slight increase over the previous month in the number of patients seen.

(c) Accidents: There was a slight increase in the number of minor injuries during the past month. Four sub-major injuries occurred, any one of which was a potential major injury. Two of these injuries occurred in the Research Group which group has had only one injury of sub-major classification prior to this.

(1) Second degree burn of hand due to spilling of hot glycerine.

(2) Second degree burn caused by steam, received in Semi-works.

(3) Fracture, contusion and laceration of finger caused by falling centrifuge which was being lifted.

(4) Fracture, contusion and laceration of finger of lathe operator in instrument shop.

No permanent disability is expected from the above injuries.

2. Special Hazards

204 Building.

An inspection was made of the recently completed 204 Building in company with Dr. Larson. Types of floor covering were discussed as it is already obvious that the present paint is unsatisfactory. The flaking and powdering will help to spread any contamination and will leave bare spots of concrete to become contaminated. Experience elsewhere has shown that wet washing of floor at frequent intervals is the best method of keeping down contamination. Special consideration was given to types of respirators to be used on clean-up jobs. Further study of the health hazards in this building will continue as the work gets under way. A Health-Physics survey worker be assigned full time. Specially constructed electrostatic precipitators have been made and will be used to measure the air contamination. Hand counters and Plutos will be used very frequently.

3. Haematology

(a) Stippled Red Cells

The total number of cases in which stippled red cells have been observed up to date is 105. they are still being seen in both the non-exposure and exposure groups. In an effort to better evaluate these findings, oxalated whole blood, blood serum and urine of five individuals showing a high degree of stippling has been sent to Dr. Schwartz for further analysis. A survey is also being made of individual past industrial exposures. When all data is complete a further analysis of these findings will be made.

(b) White Blood Counts

A summary of the white blood counts below 5000 and below 4000 is here given for both the work hazard group and the control group for the month of July.

One count only of each individual person was used, even though they had more than one during the month, and the lowest count was the one selected. Individual counts below 4000 are separately listed as below 4000 but are included also in the groups below 5000.

	Control Group		Work Hazard Group	
	No. of WBC	% of Total	No. of WBC	% of Total
No. of individuals counted	322	100	486	100
No. with a count below 5000	20	6.02	51	10.49
No. with a count below 4000	5	1.05	10	2.07

4. Safety Rules

Rules for the Safe Operation of Clinton Laboratories as a whole and of each separate area have been devised by the various Safety Committees and published for use at Clinton Laboratories. The material contained in these is of such wide interest that it was considered advisable to re-issue them as a CH report, and they will appear shortly as CH-1864.

5. Personnel

Because of Dr. Cantril's illness, Dr. Fuqua was Acting Head of the Health Division from July 4th through July 29th.

Dr. John E. Wirth was appointed to the staff of Clinton Laboratories as of July 15th.

6. Work for the Coming Month

1. Physical examinations: pre-employment, interval, transfer and termination.

2. Accident care and general Dispensary service.

3. Laboratory studies - blood and urine studies at stated intervals.

4. Continued observation of radiation hazards and methods of protection at Clinton Laboratories.

5. Supervision of medical examinations and special surveys at sub-contract plants.

6. Study of radiation hazards

7. Study of Clinical and laboratory data.

CLINTON LABORATORIES

II. PHYSICS SECTION OF HEALTH DIVISION

Report by K. Z. Morgan
Section Chief

1. Pocket Meters (L. H. Weeks)

During the month of June there were 41,141 pocket meter readings. 3.49% were single off scale readings and 0.24% were double off scale events. The probable random number of doubles is 0.12% .

In a study made, the percent of hifh readings for June and July was plotted as a function of relative and absolute humidity. There was some inconclusive indication of a slight humidity effect. Routine recharging of the desiccant in the pocket meter caps was started on June 29th. There was an average of 29.5 daily pocket meter readings above 50 mr/hr for the month preceeding June 29th and an average of 20.5 daily pocket meters above 50 mr/hr since that date. Therefore, this recharging procedure of heating all the pocket meter caps in the oven seems to give a 30% improvement.

As suggested in CH-1649, a number of high pocket meter readings are caused by dropping the meters. The number of meters dropped is increased because of those in service with dud clips. A number of these dud clips have been ground off and replaced by good clips. For fear that this grinding procedure might harm the insulator, these meters were marked with a dab of yellow paint and a separate check made on them. The present indication is that they are in good condition.

2. Badge Meters (J. R. Bradley)

The badge meters have been in service in conjunction with the pocket meters for some weeks now. To correlate high film readings with simultaneous pocket meter readings the following table has been prepared. It is a list of the average weekly meter readings for five consecutive weeks. These averages include all badge meter readings of over 100 mr/week during this period and the corresponding pocket meter weekly averages.

Date	No. of film Readings above 100 mr/week	Average film Reading	Average Pocket meter Reading
5/28 - 6/3	18	151 mr/week	126 mr/week
6/3 - 6/10	22	144	143
6/10 - 6/17	21	142	126
6/17 - 6/24	8	189	189
6/24 - 7/1	7	124	129
Total	76	Av. 150	Av. 143

* Three films completely blackened are not counted here. Evidence indicates that these films were tampered with.

Although there is at times considerable discrepancy between the individual pocket meter readings and badge meter readings, this data indicates a surprising correlation between weekly averages, when the film readings are used as a basis. If the pocket meter readings had been used as a basis for comparison the correlation would be much poorer because the pocket meters read high from various causes while the film meters record only radiation exposure. It is of interest that of the 4623 badge meters read during this period only 76 were above 100 mr/week. The four highest weekly film readings were 390, 375, 300 and 295 mr/week.

At present the badge meters are read once each week. It is now planned to read the films every two weeks after July 30th. In addition the films will be read at once after each double occurrence, i.e. both pocket meters reading greater than 200, or whenever the accumulative pocket meter reading is greater than 300 mr/week. The pocket meters have the advantage of ease of reading after any event, and each day. The badge meters are less liable to fluctuation but cannot be conveniently read as quickly.

3. Meter Contamination (E. S. Whittaker)

A badge meter was found with an unexplained exposure. It was checked with a thin walled GM counter and found to be contaminated. As a result regular procedure of checking all pocket meters and badge meters was established on July 15th. Three badge meters and one pocket meter were removed from service the first week of such measures, due to contamination. This contaminated pocket meter gave 9134 counts/minute on the GM counter. The last reading of this meter was high. Most of the contamination found on meters so far is beta.

4. Ring Meters

Two ring meters supplied by the Manhattan District Medical Office were calibrated and put into service. They hold films as the metering medium. One of the ring films used became light struck because the masking tape became loose due to heat. These ring meters should prove useful for many operations where the hands receive a large beta or gamma exposure.

5. Hand Counting (Mearl and Pearl Williams, Virginia Roark)

Three of the hand counters in the plant have been designed for self-service so each person may take his own hand count. These counts are recorded by the person on blanks for the various Groups and sent to the Health-Physics Section each day. The new Parker 4-fold hand counter was installed in Building 706-C on July 12th. This instrument counts both sides of both hands simultaneously. It is designed to be completely automatic except for the reset of the four recorders. These four recorders are reset by turning a single knob. The counting begins when the hands are placed in two holes and terminates after a set time interval. This instrument has already proven its worth because it simplifies and speeds up the operation. There have been more than twice as many hand counts per day in 706-C since July 12th.

The hand counter in 706-A has been operated as usual by a girl assigned to this work. This counter has been used in large part to count hands, gloves, hats, respirators, etc. When a high hand count is found it is

checked for both beta and gamma, and the contamination distribution is checked with an interposed lead slit. If a shoe has an outside count of 700 c/m, it is checked inside with a probe counter. Several shoes have been found with high counts inside. Several hot hats have been located, one of which gave 56 mr/hr. Caps are being secured by the plant and it will probably soon be compulsary for persons working in the Cells to wear a company cap. These caps can be washed in the decontamination laundry if necessary.

6. Decontamination Laundry (C. G. Lewis)

As an indication of what the laundry is doing, it might be interesting to examine the results of a typical week - say the week ending July 15th. During this period there were 676 garments washed. This included three batches with initial rates 1000 to 1600 c/m, five batches with initial rates 50 - 400 c/m, and the remaining twelve batches with an average of 20 c/m. After washing the three hot batches there were 21 garments with rates above 500 c/m that had to be rewashed. Some garments have required as many as four re-washings. There were eleven garments in the other seventeen batches with rates above 500 c/m. During this same week several hundred canvas and leather gloves were washed. In addition such objects as rubber gloves, overshoes and glasses were washed. All objects washed in the laundry were checked with the counter at least once. Hand counts were taken of the Laundry personnel regularly.

It was found that the decontamination efficiency of very hot garments could be increased ten times by soaking them overnight before washing.

7. Calibration (Francis Bishop)

All Lauritsen electroscopes, integrons, film badges, etc. continue to be calibrated on a routine basis. The off area integrons were put into operation during this month and are calibrated regularly.

8. Instruments

The under-water slug checked was installed this month. It is essentially an ionization chamber under-water, connected electrically to a projection electrometer.

The first of several new Parker 4-fold hand counters is in operation.

The first of six new Paint Pail meters is in operation. It is a direct reading meter using a 959 balanced circuit. It works much better than any other direct reading meter used to date.

The portable counters of both AC and DC operation are finding increased application in area survey, water surveys and as frisking meters.

9. Surveys (C. C. Gamertsfelder, R. R. Coveyou, C. M. Patterson)

The outstanding observation concerning the weekly survey reports this month is the number of good reports.

Photographs were made in Building 105 of the experimental holes of the pile. These photographs revealed defects in the concrete just above the iron frame in many of the holes. Subsequent drillings above the iron frames indicated large cavities in the grouted section.

Surveys were made of the Cafeteria and eating places of the plant with the"Walkie Counter" and with Pluto. No contamination was detected.

The radium sources were checked for leakage but none was observed.

10. Atmospheric Radiation (D. J. Rendell, J. S. Cheka, S. Block)

Routine measurements were made in the plant and surrounding area with X-22 meters, integrons, GM counters, film meters and precipitators. No unusual results were obtained.

The alpha activity in many of the rooms indicated the presence of about 3×10^{-10} μ gms/cc. The air from one of the hoods contained 110×10^{-10} μ gms/cc. (tolerance is probably $\sim 5 \times 10^{-10}$ μ gms/cc.)

11. Water Sampling

The new holding pond has been in operation this month. The old tponds are left isolated from the drainage system and are filled with water to reduce the radiation from the mud bottom. The activity of the new pond effluent is greater than had been expected. The effluent β activity has averaged about 100 counts/cc (about 1 to 2 mr/hr) and the γ activity about 1.5 mr/hr.

An instrument house was built on the edge of the new holding pond to contain the instruments for checking the water activity. This convenience, together with direct reading water counters should facilitate these measurements. The mud on the bottom of the new pond is already very active.

Mud and plant samples were collected down White Oak Creek to the dam. The activity of water below White Oak Dam is about that of the plant tap water.

12. Training Program

This month concludes the training of the first 12 regular trainees.

13. Counters (See memos of J. W. Healy to K. Z. Morgan during July)

The effective flat plate areas of several thin-walled silver counters were measured and found to be about 60% of the silvered portion for β rays from P^{32}. This information can be used in conjunction with pre previous measurements in comparing the tolerance rates of various counters.

It was indicated experimentally that the failure of some of the counters in use at high counting rates was due to the total number of counts in a short interval rather than the counting rate.

Additional experiments were made to indicate the temperature coefficient of counters in use. The alcohol counters or the old kind of counters with external quenching seem to operate best when subjected to wide variation of temperature. Amyl acetate counters in use here do not operate satisfactorily except at constant temperatures.

Experiments and calculations were made to determine the optimum wall thickness of counters for rays from radium. These experiments were more in the form of laboratory experiments for the benefit of the trainees but considerable useful information was made available. (See memos of J. W. Healy to K. Z. Morgan during July).

14. Wall Contamination

Picture frames containing samples of plasterboard, linoleum, wood, glass, etc. were placed in active areas of the plant and left for about two months in order to determine what activities would be picked up by the various materials and to check decontamination efficiency. Glass seemed to pick up more contamination than the other materials. The painted wood and linoleum seemed to pick up the least contamination. These tests are continuing in an effort to obtain more conclusive results.

15. Activity of Lead Bricks (C. M. Patterson)

It has been observed on many occasions that certain lead bricks become unusually radioactive when exposed to neutrons . Absorption curves and decay curves were run on one of these active bricks for three months and half-lives of 2.8 days and 63 days were obtained. These half-lives and the energies obtained from absorption curves would seem to indicate an abundance of the 2.8 and 50 day antimony in some of the bricks.

16. Glove Tests (P. E. Lindvig)

A large number of leaded leather gloves were checked inside and out for contamination. 75% of the gloves were above tolerance on the outside. On the inside some reached the tolerance level, 25% showed 1-4 tolerance and the rest were below that level.

The advantage of wearing gloves is shown by the radiation reduction factor as measured on gloves in service with a thin-walled Lauritsen for various substances as follows:

Kind of Glove	Reduction Factor For			
	Graphite Stringer	Coated Cold* Slug	Uncoated* Cold slug	Hot lead brick
Leaded leather	6.2	9.2	10.8	1.7
Cloth	3.5	1.2	1.1	1.2
Leather	4.7	1.7	1.6	1.4
Rubber	4.2	1.7	1.6	1.4

*It should be noted that the above values are made with the thin-walled Lauritsen against the slug and therefore correspond to the values for remote radiation as given in CL-697. The reduction factor would be considerably larger for the case of actual contact.

17. Personnel

Many changes have benn made in personnel during this month. Mr. W. H. Ray was loaned to the Chicago industrial hazards section. The following persons are in the process of being transferred to Hanford this month -

H. M. Parker, Physicist and Section Chief
C. C. Gamertsfelder, Physicist
J. N. Wilson, Special trainee
E. S. Whittaker, Special trainee
Mrs. J. P. Gamertsfelder, Clerical Assistant
C. W. Badger, Trainee
L. J. Cherubin, "
W. H. Delany "
W. H. Durum "
P. L. Eisenacher "
L. L. German "
C. G. Lewis "
P. E. Lindvig "
J. T. Lowe "
F. P. Seymour "

L'.

18. Work for the Coming Month

Routine work will consist of the following -

(a) Surveys in 100 , 200 and 700 Area
(b) Meterological Surveys
(c) Water and mud surveys
(d) Pocket and badge meter service
(e) Hand and laundry counting

Additional photographs will be made of the pile surface to find radiation through cracks.

A new training program is scheduled to begin this month.

Increased emphasis will be placed on product surveys and protection from product.

Several new health instruments are being developed.

CLINTON LABORATORIES

III. BIOLOGICAL SECTION OF RESEARCH DIVISION

Report by H. J. Curtis
Section Chief

1. Biological Effects of Pile Radiations - R. E. Zirkle, J. Raper, E. F. Riley, G. Stapleton

A. New Equipment. On July 26 construction was begun on a project to build an air-conditioned room about 15 ft. long, 9½ ft. wide and 11½ ft. high to enclose the entrances to the exposure tunnels and the adjacent space in which the animals must be kept and manipulated before and after exposure. This would eliminate heat casualties such as those suffered on May 15, 1944.

B. Exposure of Mice to Slow Neutrons (142-X11B; 142-X10B) The special carriage for this work has been completed and its operating characteristics in the lead-lined tunnel have been tested. This carriage accomodates 24 mice, each of which is shielded with bismuth from the capture of gamma radiation originating in its neighbors or other surroundings. Exposures will begin immediately after completion of the air conditioned room and possibly before.

C. Periodic Exposures of Mice to Fast Neutrons (244-X4B). On July 19 the number of slugs in the "fission carriage" was increased from 12 to its present capacity of 42. This addition approximately doubled the total n-units per kw.-hr. at the position of the mice:

	Std. n/kw.-hr		
No. of Slugs	total	from pile	from carriage slugs
0	0.0026	0.0026	0.0000
12	0.0169	0.0026	0.0143
42	0.0333	0.0026	0.0307

All of the mice which were undergoing periodic exposure at the time of the heat accident, June 18, 1944, have been destroyed. In the cages which showed only very slight mortality one or two days after the accident and which were threrfore regarded as worth saving, although of limited value, further mortality set in a few days later. These cages were accordingly judged to be of no further value.

Since June 18 new periodic exposures of mice have been initiated. Those are summarized to date in the accompanying table, which is self-explanatory except for the follwin items.

In the third column, CF_1, designates the strain of mice obtained from Carworth Farms. This is the only strain initiated to date, but it is anticipated that at least one more will be used, namely Bar Harbor Browns (BHB).

The specific controls listed in the sixth column are animals which are received from the vendor at the same time as the pertinent irradiated animals and which are always taken along with the irradiated animals and subjected insofar as possible to exactly the same manipulations except the act of irradiation. The general controls (Entries 15-17) are animals set aside from time to time to remain in the animal house without being subject to the hauling and anipulations peculiar to the technique of irradiation.

Periodic Exposures of Mice to Fast Neutrons

Entry	Periodic Dose	Strain	Sex	Irradiated Animals (XC-)	Specific Controls (XC-)	Date Begun	Total to 7/28/44	Total Dose to 7/28/44(n)
1	1.15n/day	CF_1	F	52643-68	52721-46	6/7/44	23	26.4
2		"	F	52669-94	52721-46	6/27/44	23	26.4
3		"	F	52903-27	52928-52	7/3/44	19	21.8
4		"	F	53078-102	53103-27	7/7/44	15	17.2
5		"	M	52953-77	53003-27	7/4/44	18	20.7
6		"	M	52825-50	52851-76	7/4/44	18	20.7
7		"	M	53257-81	53282-306	7/8/44	15	17.2
8	4.3n/day	"	F	52695-720	52721-46	6/27/44	24	108
9		"	F	52773-98	52799-824	7/4/44	19	82
10		"	F	53053-77	53103-27	7/7/44	16	69
11		"	F	53128-53	53154-79	7/7/44	16	69
12		"	M	52978-3002	53003-27	7/4/44	18	77
13		"	M	53232-56	53282-306	7/8/44	15	65
14		"	M	53180-205	53206-31	7/24/44	5	22
15	Gen.Control	"	F	52747-72		6/27/44	-	-
16		"	M	52877-902		7/1/44	-	-
17		"	M	53028-52		7/4/44	-	-

2. Biological Effects of External Beta Rays (246-X7B) - J. Raper, R. E. Zirkle

A. Acute total-surface exposure of mice. No significant changes have occurred since the previous report either in the mice surviving acute total-surface exposures of beta rays or in the rabbits which received acute local exposures of beta rays.

B. Sources. Search has continued for suitable materials in which to embed powders for activation in the pile. Pneholic-aldehyde plastics seem to be able to withstand the temperature and radiation within the pile, but there are impurities in the commercial materials which cause them to be very hot when they come out of the pile. Since the chief impurity is sodium, which has a 14.8 hr. half-life, the materials can be handled after a few days of cooling. We are attempting to obtain purer samples of this type of plastic, which should make handling much easier. In the meantime, the Virginia Lincoln Plastics Company has agreed to fabricate various phosphorus-impregnated plastics, and these will be tested and used as soon as they arrive.

3 . Biological Monitoring (142-X3B) - Elizabeth Anderson

Experiments are in progress to determine conditions under which rabbits may be kept around the grounds without dying of the heat. It has been found that rabbits have poor control of body temperature, so this fact is being used to test various types of exposure conditions.

An air-conditioned room is being built on the 3rd balcony on the south face of the pile, and the pile monitoring rabbits will be kept in this room as soon as it is finished.

Five of the rabbits being exposed to the pile stack gases have died or been sacrificed (Previously reported) and these have now been replaced.

4 . Metabolism of Fission Products (246-X2B) - W. E. Cohn, E. R. Tompkins, G. W. Raper, J. Khym

A. Ether extractor for hot laboratory. A temporary glass dissolver has been set up in one of the cells of the hot laboratory, and one hot slug has been dissolved. The solution was then put through the new remote control ether extractor where the UNH concentration was reduced by about a factor of 100. The super-juice was then passed through an IR-1 resin column about 5 ft. long and 8 mm. in diameter. Following water and acid washings, to remove excess UNH, 0.5% oxalic acid was passed through to remove Zr and Cb, which was shipped to Chicago for use there. The remaining fission products are being separated.

A temporary dissolver is being torn down to make room for the permanent remote control dissolver which is being installed by the Chemistry Division.

B. Adsorption Columns as F.P. Separators

Further experiments on the separation of F.P.'s by the column now indicate that tartaric acid containing one mol ammonia per mol of acid will differentiate between strontium and cerium, removing only the latter. This is being worked out and will be used in further hot separations.

C. Shipments. During the month the month the following materials have been shipped -

1. 3 shipments of phosphorus - 50 mc each - To Cole
2. 1 shipment of phosphorus - 6 c - to Hamilton
3. 1 shipment of Zr - 80 mc - To Cole

5 . Metabolism of Short-lived F.P. (244-X1B) - H. Lanz, J. Teresti

Measurements of the ionization in the gas from the fission recoil apparatus have been made over a rather extensive range of flow rates. The resulting curve is shown in Figure 1 and it will be noted that there is a definite maximum activity concentration which is reached at high flow rates. The ordinates are in microamperes through an ionization chamber and are directly proportional to the concentration of activity in the gas. An absolute calibration of this chamber has not yet been accomplished, but the maximum concentration is probably about 75 μ C/cc of gas.

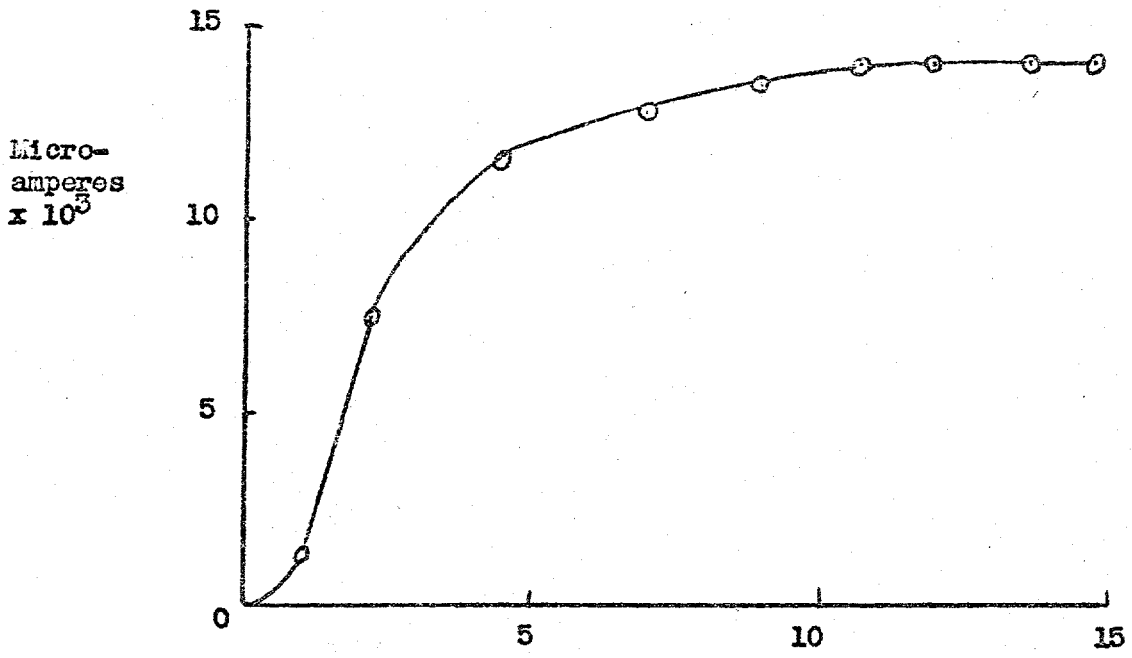

Fig. 1 - Activity Concentration in Fission Recoil Gas

The new exposure chamber which exposes only the nose and mouth of rats has been found to work very well; the animals tolerate the confinement of this chamber almost indefinitely.

A group of 3 rats have been exposed in this chamber for 5 hours per day and for 8 consecutive days with the activity at 75 μ C/cc. One was sacrificed at the end of the experiment, and the other two died within 72 hours. Histological data is not yet complete, so the cause of death is not known. However, we strongly suspect that the animals died of starvation, since the mouth and upper esophagus were badly burned, they refused to eat and lost weight steadily from the first day. This hypothesis is now being tested. Rats exposed in the same way for only one day are doing well.

Work has continued on the distribution of fission products in the body as a function of time following a single exposure. Data was given last month for a hold-up time of 2.4 seconds (incorrectly reported last month as 1.2 seconds)(64 μ C/cc) and data is now nearly complete for 1.2 seconds (75 μ C/dd) and 6.0 seconds (23 μ C/cc). These latter two are included in Tables I and II which are self-explanatory. They serve to emphasize the fact that a large fraction of the fission products are deposited in the bone and not excreted. It is also interesting to note that the concentration of fission products is still quite high in the lung and liver after 9 days. The activity of the tissues was measured by mica-window GM Counter.

TABLE I

Activity found in various organs at various times following a 5 hour exposure to the fission recoil gas with a hold-up time of 1.2 sec. activity of gas approximately 75 C/cc. 200 g. female rats; one animal per period.

Percentage of Total Absorbed Activity

Tissue	0 hrs.		48 hrs.		96 hrs.		143 hrs.	
	μC/gm	% per organ	μC/gm	% per organ	μC/gm	% per organ	μC/gm	% per organ
Thyroid	--	0.54		6.6		6.8		4.8
Lungs	4.25	17.8	1.5	7.1	.98	7.0	.97	5.8
Liver	.21	6.0	.087	3.7	.19	8.4	.14	6.1
Stomach	.69	3.98	.019	.16				
Cecum	.13	1.7	.09	1.7	.012	1.6	.008	.92
S.& Lg.Intest.	.097	2.89	.019	.65				
Kidneys	.18	1.2	.013	.11	<.01	<.1	<.01	<.1
Femur & Tibia	.23	.95	.30	1.3	.30	1.9	.30	1.9
Skeleton*	.23	15	.30	22	.3	26.4	.30	24
Rest of soft tissue	.113	52	.026	15.7	.008	5.9	.025	16
Total excreted	0	0		40.7		42.1		40.3
Total		100		99.9		100		99.9
Total μC		24.6		20.4		17.0		20.0

* Calculated by multiplying activity per gram of femur and tibia by total weight of skeleton, assuming bone comprises 10% of total body weight.

TABLE II

Activity found in various organs at various times following a 5 hour exposure to the fission recoil gas with a hold-up time of 6.0 sec. Activity of gas approximately 23 C/cc. 300 g. male rats; one animal per period.

Percentage of Total Absorbed Activity

Tissue	0 hrs.		44 hrs.		69 hrs.		93 hrs.		117 hrs.		141 hrs.		164 hrs.		214 hrs.		236 hrs.	
	μC/gm	% per organ	μC/gm	% per organ	μC/gm	% per organ	μC/gm	% per organ	μC/gm	% per organ	μC/gm	% per organ	μC/gm	% per organ	μC/gm	% per organ	μC/gm	% per organ
Thyroid		.90		4.7		6.2		2.2		3.4		3.0		1.8		1.23		5.6
Lungs	8.7	17.9	4.2	10.4	3.3	8.4	3.46	9.5	3.9	10.4	2.9	8.0	5.55	13.9	3.6	11.0	5.0	14.3
Liver	.364	6.8	.40	6.8	.36	6.9	.32	5.9	.46	7.1	.44	6.5	.71	8.75	.35	6.6	.64	8.2
Stomach	.50	2.2	.74	.30	.005	.19	.18	.96	.04	.13	.03	.12	<.03	<.1	.02	.31	<.02	<.1
Cecum	.27	1.04	1.14	5.9	.48	1.6	.32	2.98	1.1	3.6	.40	1.2	.50	2.5	.05	.51	.45	1.5
S. & Lg. Intest.	.37	8.1	.095	1.6	.17	2.2	.11	2.0	.25	3.7	.24	3.4	.11	1.1	.03	.77	.087	.91
Kidneys	.61	2.2	.71	2.96	.82	3.1	.75	2.98	.65	2.8	.62	2.6		<.5		<.5		<.5
Femur & Tibia	.37	.52	.45	.49	.51	.88	.59	1.1	.63	1.0	.73	1.7	.52	.91	.48	1.1	.46	1.14
Skeleton*	.37	14.2	.45	22	.51	23	.59	29	.63	28.7	.73	35	.52	21.8	.48	20	.46	21
Rest of soft tissue	.16	52.0	.067	25	.056	20	.02	7.3	.001	3.9	0	0	.002	7.8	.003	9.3	.003	12
Total excreted	0	0		19.0		28.0		35.6		34.4		42.3		40.9		49		35.6
Total		105.0		99.8		100.1		99.9		100.1		104.2		99.4		100		100.2
Total		85.5		74.2		72.6		71.2		76.6		65.8		71.9		64.7		65.7

* Calculated by multiplying activity per gram of femur and tibia by total weight of skeleton, assuming bone comprises 10% of total body weight.

6 . Work for the Coming Month

Acute exposures to slow neutrons should start in a few days, and chronic exposures soon thereafter. New series of chronic fast neutron and gamma ray mice will be started. New beta ray sources should be ready soon and if tests prove them to be satisfactory, exposures will begin.

It is to be hoped that we can replace all monitoring animals this month.

Work will continue on the metabolism of short-lived fission products in an effort to complete the series. In addition the experiments will continue on the purely respiratory phase of the problem.

In the chemical group, the new dissolver will be tested and certain improvements made on the ether extractor. A new and larger adsorption column will be installed.

A study is being started of the activation of tissue elements following exposure to slow neutrons.

CH -2189
X

METALLURGICAL PROJECT

A. H. Compton - Project Director
R. S. Stone, M. D. - Associated Project Director for Health

* * *

CLINTON LABORATORIES

M. D. Whitaker - Director

* * *

HEALTH DIVISION

J. E. Wirth - Director

Medical Section of Health Division

J. E. Wirth, M.D. - Medical Director

Health-Physics Section of Health Division

K. Z. Morgan - Section Chief

* * *

RESEARCH DIVISION

R. L. Doan - Associate Director for Research

Biology Section of Research Division

H. J. Curtis - Section Chief

* * *

REPORT FOR MONTH ENDING OCTOBER 31, 1944

Received Clinton: 11/2/44 Series A Issued: 11/2/44

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CLINTON LABORATORIES

HEALTH DIVISION
and
BIOLOGICAL SECTION OF RESEARCH DIVISION

ABSTRACTS

I. Medical Section

Possibilities of lead poisoning have been markedly decreased.

Over-exposure of personnel in 706-C may become a problem.

II. Physics Section

The procedure of checking apparently above tolerance exposures as shown by the pocket meters, by reading the badge meters of the individuals concerned, has resulted in a decrease to about two reports a day concerning over-exposures. In most cases the cause of the exposure is found and removed by the following day. Most of the near tolerance radiation exposures during October occurred during the "hot" run in 706C.

A Lauritsen electroscope with a removable semi-cylindrical cadmium shell was calibrated for slow pile neutrons of energy below 0.3 ~~MEV~~ EV Eitht hour tolerance is about 2500 pile neutrons/cm^2/sec of energy below 0.3 ~~MEV~~ EV.

Arrangements are being made for a decontamination laundry night shift.

The new Victoreen survey meters are not satisfactory.

A new alpha hand counter with a 35% geometry is being tested.

A modification of the Paint Pail circuit has produced an instrument which seems to be superior to other survey instruments that have been tested.

A broken slug jacket presented many new decontamination problems in the 115 fan Building.

The rainfall of 8.8 inches and the ensuing flood on September 29, 1944 flooded the settling pond and threatened to wash away White Oak Dam. Due to the large dilution factor the water activity did not rise above normal. The mud activity at White Oak Lake has decreased by a factor of $\sim$ 10.

The settling pond reduces the water activity by a factor of $\sim$10.

III. Biology Section of Research Division

Further work on adsorption columns has shown that it will be possible to reduce the uranium content of dissolved slugs to any desired level.

by this method, thus obviating an ether extractor in fission product separations. It therefore appears that the column offers the simplest practical method for the routine separation of fission products even on the hundred-curie scale.

Of the mice subjected to chronic fast neutron irradiation, all of the animals receiving 13 n/day and most of those receiving 4.3 n/day have died, after having received about 300 n; the ones on 1.15 n/day are losing weight after about 100 n.

Rabbits which have been exposed to beta ray doses ranging from 5,000 to 30,000 r to a limited area of the back have all shown qualitatively about the same response, but this response to the lower doses took somewhat longer to develop. Epilation, desquamation and ulceration are the prominent features of these burns.

Fish which have been caught periodically over the past six months in White Oak Lake have been analyzed and have shown that they accumulated moderate quantities of activity before the settling pond was built, but since then the activity has been very low.

CLINTON LABORATORIES

I. MEDICAL SECTION OF HEALTH DIVISION

Report by J. E. Wirth, M.D.
Medical Director

1. Medical Activities

(a) Pre-employment, termination and transfer physical examinations are maintaining a constant level.

(b) Dispensary service continued on a 24 hour basis.

(c) There was an increased number of near accidents, minor, sub-major and major accidents during the month. The number is not alarming and is notable only in contrast to the previous small number.

(d) The Lead Shop has been completely rebuilt and is now a model of cleanliness and efficiency. The possibility of lead poisoning has been decreased markedly. Analyses of the blood and urine of the lead burners for lead has shown a marked downward trend to within normal limits.

2. Clinical Laboratory

(a) Routine blood counts and urinalyses have continued on the same level. No noteworthy findings have been observed.

(b) The Clinical Laboratory has now become very proficient in taking Kerr Compound finger tip impressions. Approximately 300 impressions have been taken to date.

3. Special Hazards

Large "hot" runs are being continued in the "hot" laboratory of 706C. The equipment is such that it is only by constant attention and cooperation on the part of the personnel that over-exposure to personnel can be avoided. The correlation between pocket and badge meter readings of the personnel in this region has been excellent. Continued operation of this laboratory at the same levels of activity as the two previous runs is practically impossible without slight over-exposure (based on daily amounts) to some personnel.

The algae problem in the settling pond still exists. Plans have been made to eliminate the algae by means of formalin.

Revised rules concerning special hazards in the Analytical Division and in the 204 Building have been completed. All other Safety Rules and Procedures Concerning Activity Hazards for all areas of the Laboratory are now being reviewed and revised.

4. Instruments

Satisfactory alpha hand counters are not available. The four-fold beta-gamma hand counters are being delivered at a rapid rate and their installation has resulted in a markedly increased number of hand counts. The number of high hand counts recorded is ample proof of the need for these instruments.

5. Personnel

Efforts are still being made to obtain additional physicians. The turn-over of Laboratory technicians and nurses is increasing.

6. Work for the Coming Month

1. Physical examinations: Pre-empolyment, interval, transfer and termination.

2. Accident care and general Dispensary service.

3. Laboratory studies. Blood and urine studies at stated intervals.

4. Continued observation of radiation hazards and methods of protection at Clinton Laboratories.

5. Special medical examinations and surveys.

6. Study of clinical significance of radiation hazards.

7. Study of Clinical and Laboratory data.

CLINTON LABORATORIES

II. PHYSICS SECTION OF HEALTH DIVISION

Report by K. Z. Morgan
Section Chief

1. Pocket Meters and Badge Meters (J. E. Bradley)

There were 40.087 pocket meter readings during the month of September; 4.1% of these were single off-scale readings and 0.19% were double off-scale readings. The present system is to notify the Supervisor (Form A-504) of a person whose pocket meters record >100 mr on any day and whose badge meter records >25 mr when developed and read on the same day. Under this system less than two reports are sent out each day (in contrast to 15 each day when pocket meters alone were used) and in practically every case the reading was found to be due to radiation, and placed under control the day after the exposure began.

There were 1867 badge meters read during September, inclusive of those allowed to go two weeks and those read earlier because of pocket meter readings above 100 mr. There were 52 readings above 100 mr. Seventeen of these readings were from men working in 706-C during the hot run where considerable exposure was possible. The highest reading recorded for the hot run was 1250 mr for the two week period. This is considered very good in view of the magnitude of the radiation problems involved in this hot operation.

2. Hand Meters

Use of special films continued and expanded (CH-2023)

3. Neutron Monitoring

The slow neutron exposures are measured by the effect of the secondary gamma rays on the regular film packs in the badge meters. No meters are worn at present which will separate the slow neutron contribution from the primary gamma ray exposure, but this is not serious if the biological effect of slow neutrons is confined mostly to the effects of the secondary gamma rays. Surveys for slow neutrons in the pile area are conducted by placing a semi-cylindrical shell of cadmium over the Lauritsen ionization chamber and taking readings with and without this shell. This shell has been calibrated against an indium foil. The indium foil activity was determined for pile neutrons below 0.3 ~~MEV~~ EV. by taking measurements with and without cadmium in front of the foil. In this way it was found that 200 slow neutrons/cm^2/sec from the pile produce ionization in the Lauritsen electroscope equivalent to 1 mr/hr. On this basis 12.5 mr/hr (tolerance rate if continued for 8 hours) corresponds to $\sim$2500 slow neutrons/cm^2/sec (energy below 0.3 MEV).

The fast neutron exposures received by the personnel in the pile building are measured by counting the proton tracks on the 30 micron alpha particl emulsion film which is worn behind the regular film in the badge meter. During October no one received more than 10% of fast neutron tolerance (tolerance is $\sim$ 10 tracks/mm^2; CH-2057,p.8). The fast neutrons in the pile building working area are measured regularly with the double ionization chambers (Chang and Eng). The highest fast neutron reading in October was 172% of 8 hour tolerance (tolerance is $\sim$ 200 fast pile neutrons/cm^2/sec.)

4. Hand and Shoe Counting

Five of the Parker four-fold beta-gamma hand counters are now in operation. There will be seven of these units in operation at Clinton Laboratories when present orders are completed. Foot counters for checking the insides and outsides of the shoes are in use with three of these units. One girl has been placed in charge of all these counting units and she is responsible for checking the background, plateau, geometry factors and distribution of counts.*

(*A simplified procedure is used to determine that the probable error from the total count (= $.674\frac{\sqrt{\Sigma C}}{\Sigma T}$) is not consistantly less than the probable error from the residual count (= $.674\sqrt{\frac{\Sigma \Delta^2 T}{(n-1)\Sigma T}}$). In these equations the ΣC = total counts, ΣT = total time, $\Sigma \Delta^2 T$ = summation of the squares of the differences of individual rates from the average rate multiplied by the time for each interval, and n = number of readings. This test checks the statistical distribution of the data).

5. Decontamination Laundry

The number of clothes counter for alpha, beta and gamma rays in the laundry has increased considerably due to recent requirement that persons working in the Restricted Area should wear protective clothing. Rather than increase the size of the laundry materially, it is planned to add a night shift. This will required additional trained personnel for laundry counting.

6. Calibration

All Health-Physics instruments are calibrated every two weeks. The new Paint Pail seems to be the most promising beta and gamma survey instrument from the calibration point of view. The new type Victoreen survey instruments are far from satisfactory. They are not calibrated properly when they arrive and do not maintain their calibration. Twelve of 23 new Victoreen survey meters are out of operation because they cannot be set to zero.

7. Instruments

An alpha hand counter with a new type electrode constructed by C. J. Borowski of S. G. English's Section is being tested. It seems to be superior to anything yet tried. The central collecting electrode is

surrounded by a cylindrical screen which is at ground potential. The collecting electrode is made negative through a high resistance and feeds a positive pulse to the grid of a 38-tube through a specially designed high resistance condenser. It has a collection geometry of about 35% as compared to about 3% for the previous counter design.

A new "Paint Pail" circuit has been developed and constructed by C. O. Ballou of J. R. Brand's Section. This circuit is essentially the same as the former one in that it uses two 959-tubes in a balanced bridge arrangement with the ionization chamber input connected to the suppressor grid of one of the tubes. This circuit differs from the older design in that the screen grids are cross connected to the plates of opposite tubes. Thus, when the ionization chamber reduces the plate resistance on the 1st tube, a negative signal is applied to the screen grid of the 2nd tube to increase its plate resistance. The 2nd tube returns a positive signal to the screen grid of the 1st tube. Since the tubes are connected in a Wheatstone bridge arrangement, they operate in opposite phase and tend to increase the circuit sensitivity. The sensitivity would be doubled provided the plate resistance increase of the 2nd tube equalled the plate resistance decrease of the 1st tube. Another advantage of this circuit is that it secures its suppressor grid bias from the r i drop across a cathode resistance. This circuit is operated with a greater suppressor grid bias and requires only two batteries as against six used in the former circuit. This circuit has the following advantages -

1. greater freedom in selecting tubes
22. shorter time response
3. lighter and smaller
4. fewer batteries
5. linear response over a wide range
6. greater sensitivity as indicated in the table following.

OLD PAINT PAIL

(Sens. 17.8 div/volt; volume 9 liters)

Divisions Deflection	r/hr	Input Resistance	Div/r/hr
30	.039	10^{11}	770
30	1.02	10^{10}	29.4
10	6.20	10^{9}	1.60

NEW PAINT PAIL

(Sens. 23.9 div/volt; volume 2.2 liters)

Divisions Deflection	r/hr	Input Resistance	Div/r/hr
30	.029	10^{11}	1030
30	.39	10^{10}	77
10	2.15	10^{9}	4.6

8. Surveys (W. H. Ray)

Most of the surveys were of a routine nature this month. Only those things of special or unusual interest will be mentioned here.

A broken slug jacket caused the contamination of the new large fans in Building 115. There was considerable maintenance work in Bldg. 115 in October, which resulted in special decontamination problems. Canvas gloves were too porous and not sufficiently moisture resistant for this operation. Leather or rubber gloves should be used in the future. Most of the contamination was mixed with grease and oil so kerosene or CCl_4 proved very effective in removing the hand contamination. The Protection built into Building 115 by thick concrete walls is now justified, in view of readings up to 1000 mr/hr obtained in the fan areas but not in the operation areas. In the 105 canal, the water and the canal fixtures became rather contaminated. Some of the canal poles and underwater tools had to be decontaminated or replaced.

On September 29, 1944, there was an 8.8 inch rain in 24 hours at Clinton Laboratories. Flood conditions reached a critical state about 4 PM when the flood water from White Oak Creek began to wash over and through the new holding pond. The hard rains had beaten the algae to the bottom of the pond before the flood started, so probably only a small amount of active mud and algae was washed down stream. Bulldozers were used in emergency action to erect a dyke which was completed about 5 PM. If this had not been done it is possible that a good part of the settling pond together with all its active material might have washed down stream. White Oak Lake became full and was discharging over the flood apron at its maximum rate. At 5 PM the level of the water rose to within 1 ft. of the top of the dam, while it was still rising at a rate of 1 ft. an hour. Fortunately at this critical moment the rain subsided and saved White Oak Dam. Continuous readings were made of the water activity from White Oak Lake during the night of the flood and throughout the next day. The dilution factor was increased so many fold that the actual activity of the water during this period did not increase above the normal background values. The mud activity down White Oak Creek indicated a considerable decrease the next day due to the flushing action of the flood. An analysis of the muddy water showed a large increase in the barium and strontium concentration in the water which might have been serious had it remained at this level. After about a week the water had cleared up and the rate of flow and water level were back to normal.

The stream bed is being widened near the settling pond and a 2 ft. dyke built around east and south sides of the settling pond. This should protect the settling pond in the future. Consideration is being given to the construction of overflow outlets at the White Oak Dam (to prevent washing out) in case of another slightly greater flood.

9. Water Surveys

The water activity has varied considerably during the month. The inlet water to the settling pond averaged a gamma activity of about 4 mr/hr

and a beta activity of about 2 mr/hr. On occasions however these values went as high as 30 mr/hr and 10 mr/hr respectively. The outlet water averaged about 1/10 the activity of the inlet water. The gamma activity of White Oak Lake water averaged about 0.01 mr/hr (maximum reading .017 mr/hr, minimum reading was below background)

10. Mud Samples

The mud activity just above White Oak Lake dam has decreased from $\sim 10^{-3}$ μc/gm to $\sim 10^{-4}$ μc/gm since the flood. The activity of the mud below the dam does not seem to have been changed by the flood.

11. Work for the Coming Month

1. Routine work will consist of the following.

   a. surveys of all plant areas
   b. Meterological surveys
   c. Water, mud and algae surveys
   d. Pocket and Badge meter service
   e. Neutron and finger meter service
   f. Hand and shoe counting (alpha, beta and gamma)
   g. Laundry monitoring
   h. Product surveys
   i. Instrument calibration
   j. Shift surveys

2. Work will continue on product decontamination procedure for the laundry.

3. New Health-Physics instruments that are developed by this Section, the Instrument Shop and English's Section will be tested.

CLINTON LABORATORIES

III. BIOLOGICAL SECTION OF RESEARCH DIVISION

Report by H. J. Curtis
Section Chief

1. Biological Effects of Pile Radiations: R. E. Zirkle, J. R. Raper, E. F. Riley, G. E. Stapleton

A. Effects of Single Doses of Slow Neutrons on Mice (142-X11B)

The status of this series is as reported last month (CH-2057, p. 13) except that one more animal which received 520 arbitrary units on 9/13/44 died within three weeks after irradiation. This reduces the three-weeks survival after 520 units to 8 per cent.

B. Effects of Small Periodic Doses of Fast Neutrons on Mice (142-X13B)

Exposures of the groups of animals listed in the last monthly report (CH-2057, p. 15) have been continued. As of 10/27/44, this experiment stands as shown in the accompanying table. Complete mortality has occurred in all four groups which were receiving 13 n/day. Of the eight groups which have been receiving 4.3 n/day, six have terminated in complete mortality, while in the other two mortality is practically complete. Some mortality is becoming evident in certain groups which are receiving 1.15 n/day. This means that considerably smaller daily doses will have to be used in order to attain a really chronic system of exposure to fast neutrons. Such periodic doses will be initiated during the next month.

The general control mice are omitted from the tabulation of the periodic fast neutron exposures and are dealt with in Section E which follows.

C. Delayed Effects of Single Doses of Fast Neutrons on Mice (142-X15B)

Eight additional sublots of about twenty-five mice each have been exposed. The status of the experiment as of 10/28/44 is as followes. Mortality is indicated by a fractional notation; for example, 18/26 means that 18 mice of an original group of 26 have died.

TABLE I

Periodic Exposures of CF_1 Mice to Fast Neutrons (142-X13B)

Entry	n/day	Sex	Irradiated Animals (XC)	Control Animals	Date Begun	Total Dose to 10/27	Orig. No.	Mortality						Remarks
								Irradiated			Control			
								Acc.	Sac.	Other	Acc.	Sac.	Other	
1	1.15	F	52643-68	52721-46	6/27/44	102	26	1	1	5	1	1	1	Growth apparently retarded
2	1.15	F	52669-94	52721-46	6/27/44	102	26	0	1	3	1	1	1	" " "
3	1.15	F	52903-27	52928-52	7/3/44	98	25	1	1	7	0	1	1	" " "
4	1.15	F	53078-102	53103-27	7/7/44	93	25	0	1	0	2	1	1	" " "
5	1.15	M	52953-77	53003-27	7/4/44	96	25	0	1	7	1	1	5	" " "
6	1.15	M	52825-50	52851-76	7/4/44	95	26	0	1	2	0	1	1	" " "
7	1.15	M	53257-81	53282-306	7/8/44	93	25	0	1	19	1	1	6	" " "
18	1.15	M	53568-86	53587-605	8/12/44	67	19	0	1	9	0	1	0	" " "
8	4.3	F	52695-720	52721-46	6/27/44	322	26	0	1	25	1	1	1	Complete mortality on 10/5/44
9	4.3	F	52773-98	52799-824	7/4/44	314	26	0	1	25	0	1	1	Complete mortality on 10/11/44
10	4.3	F	53053-77	53103-27	7/7/44	335	25	-	1	24	2	1	1	Complete mortality on 10/24/44
11	4.3	F	53128-53	53154-79	7/7/44	348	26	-	1	24	1	1	0	
12	4.3	M	52978-3002	53003-27	7/4/44	302	25	0	1	24	1	1	5	Complete mortality on 10/4/44
13	4.3	M	43232-56	53282-306	7/8/44	298	25	0	1	24	1	1	6	Complete mortality on 10/11/44
14	4.3	M	53180-205	53206-31	7/24/44	242	25	0	1	24	1	1	6	Complete mortality on10/3/44
19	4.3	M	53254a-79a	53280a-305a	8/5/44	266	26	0	1	23	1	1	1	
20	13	F	53658-83	53606-31	8/21/44	364	26	1	0	25	0	1	6	Complete mortality on 9/22/44
21	13	F	53684-709	53632-57	8/21/44	299	26	0	0	26	0	1	1	Complete mortality on 9/18/44
23	13	F	54382-407	54408-33	9/20/44	273	26	0	0	26	0	0	0	Complete mortality on 10/23/44
24	13	M	54101-26	54127-52	9/17/44	312	26	0	0	26	0	0	11	Complete mortality on 10/19/44

TABLE II

Dose(n)	Sex	Strain	Date irrad.	Serial Numbers (SD) Exposed	Serial Numbers (SD) Control	Mortality Exposed	Mortality Control
90	F	CF_1	10/6/44	54694-719	54642-67	18/26	3/25
90	F	"	10/6/44	54668-93	54642-67	16/24	3/25
90	F	"	10/6/44	54798-823	54824-49	16/26	0/26
90	M	"	10/3/44	54564-89	54434-59	6/26	2/24
90	M	"	10/3/44	54590-615	54434-59	9/26	2/24
78	F	"	9/5/44	53788-813	53762-87	1/25	1/25
78	F	BH	9/7/44	53915-38	53892-914	0/24	0/23
78	F	"	9/7/44	53963-86	53892-914	0/24	0/23
78	F	CF_1	9/12/44	54153-78	54179-204	7/26	0/26
78	F	"	9/12/44	54025-29	54179-204	1/25	0/26
78	M	"	9/5/44	53814-39	53866-91	2/26	1/26
78	M	"	9/5/44	53840-65	53866-91	5/26	1/26
78	M	"	9/7/44	54053-76	54077-100	6/23	1/24
60	M	"	10/9/44	54746-71	54772-97	1/26	0/26
60	M	"	10/9/44	54721-45	54772-97	8/25	0/26
30	F	"	8/5/44	53354-77	53378-401	0/23	1/23
30	M	"	8/5/44	53422-41	53492-21	4/19	0/18

Of the 128 mice exposed to 90 n, 65 died within three weeks Thus the three-weeks survival is 49 per cent. In earlier experiments, in which the source of fast neutrons was the pile rather than the fission carriage, the dose for 50 per cent three weeks survival was found to be 89 n. The agreement is satisfactory.

D. Effects of Small Periodic Doses of Hard Gamma Rays on Mice (142-X12B)

By use of the activated manganese source (CH-2957, p. 14) two groups of twenty-five CF_1 mice have been started on exposures to hard gamma rays; their status as of 10/27/44 being as follows:

TABLE III

r/day	Sex	Serial Numbers Exposed	Serial Numbers Control	Irrad. Begun	Total dose to 10/27/44
8.6	F	54486-511	54460-85	9/27/44	181 r
8.6	F	54512-37	54460-85	9/27/44	181 r

The selection of 8.6 r as a suitable daily dose was arrived at as follows: One of the objects of the periodic gamma ray exposures is to determine whether or not the relative effectiveness of fast neutrons and gamma rays is identical for both acute and chronic effects. For acute killing of CF_1 mice (three-weeks survival), 7.5 r of gamma rays have been found to be equivalent to 1 n of fast neutrons. A large series of fast neutron exposures are already under way at the level of 1.15 n/day. If the relative effectiveness of neutrons and gammas is identical for both acute and chronic effects, then a gamma ray dose level of 7.5 x 1.15 or 8.6 r/day should yield chronic results identical to those of 1.15 n/day. If

identical chronic results are not obtained, then it will be easy to determine whether the chronic effectiveness ratio is larger or smaller than 7.5 r to 1 n, although its precise numerical value may be undeterminable with the limited number of dose levels which it is practicable to run.

E. General Control Mice.

As has been indicated in earlier reports, it has been the practice in all experiments in which delayed results are anticipated, to use two types of controls: (a) specific controls which consist of groups of animals obtained in the same shipment as the irradiated animals and which are subjected to all hauling and manipulations undergone by the irradiated animals with the exception of the exposure itself; (b) general controls which consist of groups of animals set aside from time to time and which are never removed from the animal house. The general controls serve for all experiments done with animals received at or about the same time.

Observations on specific controls are reported with those on the irradiated animals (cf. Sections B, C and D above). The general controls, which have been given the dode designation XO-, are listed in the following table. Also included in the table are the specific controls which have been used in experiments involving only one irradiation and which have therefore been out of the animal house only once. These particular specific controls obviously constitute a very good set of secondary general controls.

On the basis of all the mice tabulated, the mortality rate of unexposed CF_1 mice kept in the animal house is 1.5 per cent per month. No corresponding figure for the Bar Harbor ABC strain can be given, since the data are too scanty

TABLE IV

General Controls and Controls Taken out of Animal Farm Only Once - Strain CF_1

Serial Numbers	Sex	Orig. Number	Mortality Acc.	Sac.	Other	Date Begun	Remarks
XO 52747-72	F	26	0	1	0	6/27/44	
XO 52877-902	FM	26	-	-	-	7/1/44	Discontinued: sexes mixed
XO 53028-52	M	25	-	1	2	7/4/44	
XO 53543067	F	26	0	1	2	8/9/44	
XO 53401-52	F	22	0	0	0	9/7/44	
XO 54330-55	M	26	-	-	-	9/17/44	Discontinued: worm infested
XO 54356-81	F	26	0	0	0	9/19/44	
XO-54538-63	F	26	0	0	0	9/27/44	
XO 54616-41	M	26	0	0	0	10/2/44	
XO 54642-67	F	25	0	0	3	10/6/44	

TABLE IV (Cont'd)

Serial Numbers	Sex	Orig. Number	Mortality Acc.	Sac.	Other	Date Begun	Remarks
XD 54824-49	F	26	0	0	0	10/6/44	
XD 54304-29	M	25	0	0	0	9/22/44	
XD 54434-59	M	24	0	0	2	10/3/44	
XD 53762-87	F	25	0	0	1	9/5/44	
XD 54179-204	F	26	0	0	0	9/12/44	
XD 53866-91	M	23	0	0	1	9/5/44	
XD 54077-100	M	24	0	0	1	9/7/44	
XD 54772-97	M	26	0	0	0	10/9/44	
XD 53378-401	F	24	0	1	1	8/5/44	
XD 53402-21	M	19	0	1	0	8/5/44	
XE 53206a-53229a	F	24	1	1	0	7/31/44	
XE 53330-53	F	24	0	1	0	8/3/44	
XE 53442-65	F	24	0	1	0	8/7/44	
XE 53736-61	F	24	0	0	1	8/31/44	
XE 53516-41	F	24	0	1	1	8/16/44	
XE 54009-30	F	22	0	0	1	9/8/44	
XE 54254-77	F	24	0	0	1	9/13/44	
Strain ABC (Bar Harbor)							
XO 53939-62	F	24	0	0	0	9/7/44	
XD 53892-914	F	23	0	0	0 9	9/7/44	

2. Biological Effects of External Beta Rays (246-X7B): J. R. Raper, R. E. Zirkle, J. E. Wirth, K. K. Barnes

A. Acute Exposure to Restricted Area in Rabbits

Observations have been continued during the month on the rabbits exposed to a single dose of Beta rays to a restricted area of the back during the period 8/30/44 to 9/9/44. Doses ranged from 5,000 to 30,000 r measured in air at a level corresponding to the surface of the skin. Sufficient time has now elapsed for the general course of the reaction to be evident. Unmistakable damage to the skin has been observed in all dose level groups, and follows the same developmental pattern at the widely different doses employed. Furthermore the relative intensity of the reaction was much less than might be expected at the different dose levels. The post-irradiation time at which the various stages become evident, however, varied significantly at different doses, the interval being longer at lower dose levels.

The general pattern of the reaction up to 50 days following irradiation is as follows:

a. Epilation: Occurred in all treated animals but was incomplete in so far as coarse hair was concerned at lower doses.

b. Separation of Superficial Layers from Underlying Tissues: The second effect which was observed and which was very characteristic

3. Metabolism of Short Lived Fission Products (244-X1B) H. Lanz, J. Teresi

The following experiments are in progress, none of which are ready for reporting at present.

a. Metabolism experiments on rats run at low gas activity and carried over a period of 128 days.

b. A check on the lethal dose of this gas for rats.

c. Radioautographic studies on rats in an attempt to discover the route of exit of insoluble compounds from the lungs.

4. Metabolism of Fission Products (246-X2B): W. E. Cohn, E. R. Tompkins, G. W. Parker, J. X. Khym, S. Weiss, J. Teresi

Another large scale fission product separation, such as that reported last month, is in progress, but results are not yet ready to report. Most of the effort of the group has been confined to developmental work on adsorption columns.

The adsorption column has been found to lend itself admirably to remote control methods, and investigations on the design of this equipment have have shown that it should be possible to operate on a routine basis for the production of fission products on the hundred-curie scale. An example of the simplicity of operation was shown by the fact that the columns which have been developed in the cells of the "hot" lab. were turned over to members of the Chemistry Division who then used them very sucessfully by following "cook-book" directions.

Investigations with ammonium salts of citric acid indicate that they may be used, perhaps more effectively than the tartrate salts discussed last month. The order of removal of the fission species as one increases the pH (by addition of NH_4OH to citric acid) remains the same; Y, Ce, Sr, Ba. Between the maximum rates of Y and Ce occur those of such rare earths as Pr and Eu, and the tracer runs indicate that these may be more easily separable by adsorption methods than any other way. Even in the run reported last month (D-9), at which time these facts were not known, a fraction rich in such rare earth species was separated between the Y and Ce cuts. These are being worked upon by the Chemistry Division as well as by ourselves in order to discover their identities.

A number of tracer experiments have been undertaken to determine the saturation point of the column for UNH. This is important, since it will determine the feasibility of using columns for the separation of fission products directly from dissolved slugs without the necessity of the troublesome and hazardous ether extractor. The experiments indicate that to remove the uranium from a solution of 100 slugs would take a column only 4 feet in diameter and 3 feet long. This therefore appears to be a very practical solution of the ether extraction problem for the separation of fission products.

B. Total Body Exposure to Beta Rays.

On 10/13/44 phosphorus-impregnated phenol-aldehyde plastic was removed from the pile after activation for 18.85 megawatt days. Following a weeks cooling, ten mouse exposure chambers, three rat exposure chambers, and a single rabbit chamber were assembled and beta ray intensity was measured at the center of each chamber. The measurements at the center of the mouse chambers averaged 6550 r/hr; for rat chambers, 5450 r/hr; and for the single rabbit chamber, 4750 r/hr. These measurements were made with a small cylindrical ionization chamber and a Beckman amplifier. The calibration of this instrument was based on extrapolation chamber measurements of P^{32} thick samples.

Exposure of mice was begun on 10/20/44 and of rats and rabbits on 10/23/44. The following exposures have been scheduled and will be completed on November 7. The dose given here is that administered to any point on the animal surface and is one-half the dose as measured by the ionization chamber at the center of the exposure unit.

Dose (r)	Mice ♂	Mice ♀	Rats	Rabbits
15,000	10	20	6	3
10,000	10	20	6	3
7,500	10	20	6	3
5,000	44*	26	9	4
4,000	20	30	9	4
3,000	20	30	9	4
2,500	44*	26	9	4
1,500	20	30	9	4
Specific controls**	25	25	9	8
General Control	25	25	-	-

*This figure includes in each exposure group 24 animals for histological study. In each group two exposed animals and one control animal are to be sacrificed at the following intervals after irradiation: 0 hours, 3 hours, 8 hours, 1 day, 3 days, 6 days, 10 days, 15 days, 3 weeks, 4 weeks, 7 weeks, and 12 weeks.

** Specific control animals will be confined within inactive phosphorus-plastic boxes for a time equal to the exposure to the 15,000 r dose.

C. Chronic Exposure of Mice to Beta Rays

Preliminary tests have been made on a mouse exposure chamber using a Beta ray emitting fission product, 57 day Y^{92}, as the source. Twenty-one millicures was equally divided between six panels which formed the sides of the chamber, giving a beta ray intensity of 470r/hr measured at the center of the chamber. Either 57 day Y or 55 day Sr^{89}, depending on availability, will be used to make the chambers for the chronic exposures. Dose increments will be decided when survival data on the current acute series are available. Fabrication of sources and the initiation of exposures are planned for the coming month.

of the response to higher doses was the complete separation of the superficial layers of skin. This separation can only be detected at first by a characteristic wrinkling of the skin under very slight pressure. During the week to ten days following its first appearance, the free layers become hard and form permanent folds or wrinkles with long transverse cracks between the folds. This response was seen in two of six animals receiving 10,000 r, and in all animals receiving 15,000 r and above, whereas no case was seen at doses lower than 10,000 r. The average time at which the separation of the outer layer was evident at each of the different doses was: 30,000 r, 23 days; 20,000 r, 28 days; 15,000 r, 31 days; and 10,000 r, 28 days (in 2 of 6 animals).

c. Desquamation: Loss of the outer layers of skin from the central portion of the irradiated area occurred in all dosage groups. In the early stages of this reaction the outer layer of skin could be detached, carrying with it the short downy hair and exposing a dry pink surface beneath. Usually in removing this loosely-adhering outer layer the long hairs were also removed, but in some cases near the edge of the treated area or extending inward toward the center of the area in lower doses, the long hair remained attached in the deeper tissues. Only in a few isolated cases (and occurring much later than the epilation described above) have areas been seen from which the hair could be removed without also removing the outer layers of skin. The average post-irradiation time for the onset of dry desquamation at the different doses is as follows: 30,000 r, 28 days; 20,000 r, 28 days; 15,000 r, 39 days; 10,000 r, 40 days, 7,500 r, 44 days; and 5,000 r, 41 days.

Wet desquamation became evident in many cases one to two weeks following the onset of dry desquamation. Loss of the outer layer of skin revealed a wet, red surface which bled easily. All hair was removed with the superficial layer of skin in such cases. A turbid, viscid fluid was frequently found in considerable quantity at this stage, subsequently forming a tough crust over the surface following the sloughing off or removal of the free layer. The area of wet desquamation was usually confined to the center of the irradiated area and shaded into a peripheral region of dry desquamation. Wet desquamation occurred in somewhat higher percentage of cases and about a week earlier at high doses than at low doses.

d. Healing: The skin of the healed surface following dry or wet desquamation appears thin, dry and papery.

e. Growth of New Hair: Around the periphery of the irradiated area and in a few cases in the center where desquamation occurred early, new hair has grown. This hair is predominately grey and characteristically long and corase; the fine down hair is lacking.

It therefore appears that the column offers the simplest practical method for the routine separation of large quantities of fission products.

5. Biological Monitoring (142-I3B)

A. Rabbits - Elizabeth Anderson

Nine of the monitoring rabbits have been bred and have produced normal litters.

B. Fish - J. P. Teresi, J. I. Khym, G. W. Parker, G. Salley

Fish have been caught from time to time from 4/27/44 to 10/7/44 and their tissues analyzed for activity. Table V gives a summary of the data. It will be noted that the fish caught on 5/3/44 had a moderate quantity of activity in the organs, and that thereafter the activity progressively decreased. It would be unwise to place too much faith in this one fish, but we believe that it is probably not far from correct for several reasons - a) the controls were analyzed at the same time and found to be background; b) subsequent fish have not varied markedly from fish to fish, so it would be difficult to ascribe it to biological variation; c) the distribution of activity in the various organs is about the same as in subsequent fish.

It is interesting th correlate this activity with the activity on the mud of the lake. Active solutions from the waste tanks were emptied into the creek starting about 3/6/44 and continued to about 4/27/44 at which time the activity on the mud of the lake had reached values of about 10^{-2} μc/g (Hamilton) and dumping was discontinued. The first fish was caught just after this. About 5 weeks after this (6/9/44) two fish were caught and the activity was down by about a factor of 100. On 7/4/44 another mud analysis was made (Eisenacher) and it was found that the activity had decreased by a factor of 100 to 1000. On 7/3/44 the new settling basin was finished and flow of active solutions was started again down the creek 7/6/44. The activity of the mud started rising again (CH-2023) but fell off during September to about 3×10^{-5} μc/g (Morgan) and fish were caught on 9/8/44 and their activity was down by about a power of ten from the previous catch. Thus, whereas neither the mud or fish analyses are complete, they do seem to follow each other remarkably closely.

The highest specific activity which was found was in the heart of the first fish. No attempt has been made to determine the elements responsible for this activity. However, if one assumes and average energy of 0.5 MEV for the particles, then the organ was receiving radiation at the rate of 2.4 r/day when it was caught. All other organs in fish caught subsequently are several powers of ten below this.

One would therefore conclude that for the welfare of the fish in the lake it was well that the new settling basin was built.

TABLE V

Activity in c/gram of tissue, measured by a thin mica-window counter, of various organs from fish caught in White Oak Lake at the times indicated. Figures indicate averages of all fish in the group. All organs were not analyzed in all fish.

Tissue	1 catfish 5/3/44	1 catfish 1 perch 6/9/44	9 catfish 10/28/44	2 perch-controls 4/28/44
Muscle	1.6×10^{-2}	--	2.1×10^{-5}	Background
G.I. tract	1.4×10^{-2}	1.7×10^{-4}	2.0×10^{-5}	"
Kidney	6.0×10^{-2}	4.7×10^{-4}	2.0×10^{-5}	"
Heart	7.8×10^{-2}	46.0×10^{-4}	18.0×10^{-5}	"
Liver	1.0×10^{-2}	4.1×10^{-4}	3.0×10^{-5}	"
Bone	--	--	16.0×10^{-5}	--
Skin	--	--	4.8×10^{-5}	--
Carcass	$.28 \times 10^{-2}$	$.14 \times 10^{-4}$	--	"

6. Work for the Coming Month

The observations and exposures to external radiations will be expanded as new mouse quarters become available.

The developmental work on adsorption columns will continue and it is hoped that a hot separation can be tried using columns exclusively.

[redacted]

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METALLURGICAL PROJECT

A. H. Compton - Project Director
R. S. Stone, M.D. - Associated Project Director for Health

* * *

CLINTON LABORATORIES

M. D. Whitaker - Director
R. L. Doan - Associate Director for Research

* * *

HEALTH DIVISION

S. T. Cantril, M. D. - Director

HEALTH-PHYSICS SECTION OF HEALTH DIVISION

K. Z. Morgan - Section Chief

* * *

BIOLOGY SECTION OF RESEARCH DIVISION

H. J. Curtis - Section Chief

* * *

REPORT FOR MONTH ENDING AUGUST 31, 1944

Received Clinton: 9/2/44
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CLINTON LABORATORIES

HEALTH DIVISION
and
BIOLOGICAL SECTION OF RESEARCH DIVISION

ABSTRACTS

I. Medical Section

A scum consisting of algae and radioactive deposits is creating a problem in connection with waste disposal in the new settling pond.

Satisfactory alpha hand counters are still a problem.

II. Physics Section

About 15% of the high pocket meter readings can be identified with radiation exposure. Rough handling and loose caps probably account for most of the high readings.

Ring meter tests have shown them to be useful.

The English-East hand counter (the only one to date to be at all satisfactory) is meeting a need in the product laboratories.

An alarm system has been installed in the hot lab to warn of high radiation levels in various parts of the building (known as Octopus alarm system)

Comparative lists of Sneezy and the Clinton Precipitron showed (1) that the precipitron indicated greater concentration of product in air than Sneezy (2) that using air already passed through Sneezy it still indicated a higher concentration.

Atmospheric radiation was found to be directly correlated with the activity of the pile. At the points ofmeasurement the activity was found to be greater during the day than at night.

Radioactive scum formed by algae is collecting on the surface of the settling pond and is found in various parts of White Oak Creek system.

Mud samples indicate a progressive increase in the activity of the drainage system at varying points during the past two months.

III. Biology Section of Research Division

Mice have been exposed to graded doses of slow neutrons and preliminary results indicate that the median lethal dose is of the order of an 8 hour exposure to a slow neutron flux of $6 \times 10^8 n/cm^2/sec$. The fast neutron chronic series are continuing and several new ones have been started during the month.

The work on the separation of fission products by means of adsorption columns has progressed to the point where it is possible to separate Zr - Cb, Y, Ce, Sr and Ba and perhaps Ru, Te and I from a fission mixture. It now looks possible to eliminate entirely the necessity of "hot" chemistry in fission product preparations, with its attendant exposure hazard, and rely entirely on adsorption columns.

During the month the chemistry division has completed the all-glass remote controlled dissolver, and we have completed the final tests on both stages of the remote controlled ether-extraction apparatus. It should now be possible to turn out relatively large quantities of very pure "super-juice".

It has been found that following an exposure to air-born fission products for periods up to 31 days about 20% of the original material is fixed in the bones, but the specific activity is still higher in the lungs than in the bones.

CLINTON LABORATORIES

I. MEDICAL SECTION OF HEALTH DIVISION

1. Medical Activities

Medical Activities have remained on the same plane, except for a slight increase in the number of pre-employment physical examinations and transfer examinations.

(a) Dispensary service continued on a 24 hour basis.

(b) Accidents: Major - 1 non-tabulatable major injury

Sub-major - 3 sub-major injuries; two fractures and one eye injury.

2. Haematology

Nothing out of the ordinary has occurred. The total number of people with stippled cells has now risen to about 123. It was noted by the medical technicians that the incidence of stippled cells is almost proportional to the amount of time spent looking at the smears.

3. Special Hazards

The radiation leakage found around the experimental holes of the pile was found to be due to defects in the concrete. This has been cured almost entirely by re-drilling and pouring in new groute.

The 204 Building has been completed and satisfactory runs are being made without hazardous incidents.

The new settling pond has been completed. A new difficulty has arisen in this. Scum appears on the surface of the pond which is highly active. This scum has been found to contain a large amount of blue-green algae, moderate amount of green algae and small amounts of other mixed types of algae. The algae seems to grow on the bottom of the pond where they become covered with a radioactive sediment. Later masses break off and because of entrapped gases rise to the surface. This has been a rather bad feature because the wind causes the material to collect in localized areas of the pond. An attempt has been made to control the algae with copper sulphate but as yet it has not been too successful. It has been found that if the material is broken up into small particles it will sink again due to liberation of the entrapped gas. The breaking up has been accomplished by spraying with a fire hose and occurs spontaneously during a rain storm. Some of this material has escaped from the pond into the White Oak Creek where it again tends to collect in various areas. This collection of scum is quite radioactive and further study of the problem is under way.

4. Instruments

Sufficient Plutos are now available so that the various areas can be adequately surveyed. There has been a crying need for a suitable form of alpha hand counter. Two instruments constructed according to English' modification have been put into use and found sufficiently satisfactory to warrant making 2 or 3 more for the laboratory while awaiting a better development.

5. Personnel

Dr. Cantril was convalescing all month. Dr. Farney started a six month leave of absence in the middle of the month. No replacements have been found.

6. Work for the Coming Month

1. Physical examinations: pre-employment, interval, transfer and termination.

2. Accident care and general Dispensary service.

3. Laboratory studies. Blood and urine studies at stated intervals.

4. Continued observation of radiation hazards and methods of protection at Clinton Laboratories.

5. Supervision of Medical examinations and special surveys at sub-contract plants.

6. Study of radiation hazards.

7. Study of Clinical and Laboratory data.

CLINTON LABORATORIES

II. PHYSICS SECTION OF HEALTH DIVISION

Report by K. Z. Morgan
Section Chief

1. Pocket Meters (J.E.Bradley)

In July there were 43,524 pocket meter readings with 3.60% single off-scale readings and 0.18% double off-scale readings. The number of statistically probable double off-scale readings was 0.19%. This would seem to indicate that most of the double events of off-scale meters were due to random discharges rather than to cases of radiation exposure exceeding 200 mr/day. Some of the meter readings in various areas for July were as follows:

Area	POCKET METER READINGS FOR JULY					BADGE METER READINGS
	Total Readings	Singles of 200 mr.	Doubles of 200 mr.	Statistically Probable Doubles of 200 mr.	Total Doubles of 100 mr. or more/day	100 mr/wk. 7/1 - 7/23/44
Chemistry Labs.	8662	303 3.5%	12 0.14%	10 0.12%	58 .67%	20
Pile and Physics Lab.	4280	134 3.1%	11 0.26%	4 0.10%	22 .51%	7
Extraction Area	8348	270 3.2%	11 0.1%	8 0.10%	47 .56%	4
Maintenance	9137	350 3.8%	24 0.26%	13 0.14%	115 1.26%	5

The pocket meter Form A-504 is sent out each day to the Supervisors of all persons who receive 100 mr/day reading on both pocket meters. The reading sent out is the lower of the double reading. These blanks are filled out by the Supervisor who in turn gives information that might account for the reading of 100 mr/day. An examination of these returned blanks for the period July 15 - August 15 gives the following results.

Reports not returned	24
Reports of meter dropped	33
Reports of meter cap off	11
Exposure unlikely but engaged in very rough work	108

Report exposure unlikely and no explanation	113
Exposure likely but not definite	29
Exposure almost certain	23
	341

This information emphasizes again the importance of handling the meters carefully. A new type of dismountable rack for dispensing the meters has been installed in the clock alleys. It is believed that this may reduce the dropping of meters in the clock alleys. Also a rotating squirrel cage has been installed in the meter room and all high meters hereafter will be tested in it for several hours to see that they are not too easily discharged due to light shock. All meters that give high readings for any cause are put through a number of routine tests. The meters that are not in good order are given an overhauling by two girls who are giving full time to meter repair at present.

An increasing number of meter failures is due to the meter caps dropping off in the pocket. These caps have to be made of pure, soft aluminum and at best it is difficult to make a thread of this material which will stand up with repeated use. However, the caps are poorly designed in that only two threads engage when the cap is screwed on tightly. These caps are being refinished by the shop at the rate of 20 per day. Tests made on these meters indicate that no change in electrical capacity is introducted by the new cap design.

2. Badge Meters (J.E.Bradley)

The badge meters continue to give convincing evidence of radiation exposure. There were 36 persons between July 1st and July 23rd with badge meter readings above 100 mr/wk. The highest badge meter reading during this period was 290 mr/wk. Thus no one has had a serious over-exposure based on the weekly total of .6 r. All badge meters and pocket meters are tested with a GM tube regularly for contamination.

A new calibration rack was put in use August 2nd. It consists of a section of a cylinder 25 cm in radius and 10 cm wide. It is made of aluminum and has a source holder at the center of the circle. The axis of this section is horizontal. It is an improvement over the old type holder in that it is easier to use and the films cannot move out of alignment as they did frequently with the old arrangement.

The type of film formerly packaged as No. 552 is no longer available and has been replaced by package No. 552-1. The average relative density of these unexposed film is as follows:

Type	Av. Density
552 - Sensitive film	.201
552 - Insensitive film	.221
552-1 - Sensitive Film	.241
552-1 - Insensitive film	.360

An Eastman 30 micron α particle emulsion film is being worn by the personnel in the 105 Bldg. It is inserted in the badge meter behind the two regular films. These films will be observed with a microscope and the alpha tracks counted at the end of each two week period to determine the neutron exposure of those persons who work in the pile area.

3. Ring Meters (J. W. Healy)

Experiments are continuing with the use of films in rings. The films used in these rings this month were packaged here. They were cut from the 552-1 films in the form of small discs. These films were wrapped in black paper one mil aluminum foil and dipped in paraffin. This is an improvement over the former films in that these are both light tight and water proof.

An operation in the preparation of a barium sample typifies the usefulness of film rings. The two men doing this work stayed behind shields as much as possible but the hands received considerable soft radiation. The results were as follows:

	Pocket Meter	Film Ring
Operator 1	15 mr	170 mr
Operator 2	25 mr	650 mr

The rings are rather bulky and tend to cut the rubber gloves. Some of these paraffin coated films are being worn loosely in the gloves or taped to fingers. The results are encouraging.

4. Hand Counting (Thelma Redmon)

The Parker 4-fold hand counter continues to prove its worth in 706C. In this Building there were 316 hand counts during the month prior to its installation and 551 during the month since (a 75% increase).

Two α hand counters of the English-East design have been put into use. The head of this instrument consists of seven small cylindrical chambers connected in parallel. These chambers feed into an amplifier and a scaling circuit. The hand to be tested is placed over the ends of these cylindrical chambers (hand perpendicular to the axes of cylinders). The average geometry for hand contamination is probably of the order of 10%. This instrument is the first one to be at all satisfactory. It is the only design available at present which has a high sensitivity and is practically non-microphonic.

5. Decontamination Laundry (Virginia Roark - Mary Oxendine)

The beta and gamma counting of clothes on the incoming and outgoing laundry continues on a routine basis. For the past two weeks each outgoing garment has been checked with the Pluto for α contamination. Seven coveralls have been found with α counting rates above 1000 c/m. The following table gives some idea of the magnitude and efficiency of the laundry beta and gamma counting system. A garment is rewashed until its counting rate is less than 500 c/m or until it is more profitable to destroy it.

LAUNDRY DECONTAMINATION OF β AND γ EMITTERS

	COVERALLS		RUBBERS & GLOVES		REWASH	
Date	Number Washed	No. with > 500 c/m after Washing	Number Washed	No. with >500c/m after Washing	Number Washed	No. with >500 c/m after Washing
7/15/44	676	32	248	222	-	-
7/22/44	1048	18	177	5	75	54
7/29/44	1108	34	357	45	97	76
8/5/44	923	19	12	3	135	124
8/12/44	950	32	566	59	77	65
8/19/44	1319	31	376	48	56	15
8/26/44	1210	66	324	28	72	15

6. Calibration (E.M.Johnson)

All the Health-Physics survey instruments and integrons were calibrated on a routine basis during this month. These instruments consisted of 23 Lauritsens, 14 Plutos, 2 Paint Pail meters,10 Victoreen survey meters, 4 Victoreen probe meters, 25 Victoreen integrons (only 15 of which are in working order) and 2 Landsverk survey meters. In addition a number of GM survey meters, pocket meters and films were calibrated.

7. Instrument (W. H. Ray)

An "Octopus" alarm system has been located in the hot lab (706C). This instrument consists of five thin-walled GM tubes feeding through long cables to a counting rate integrating meter. The first amplifying stage of each of the five counters is connected directly to its respective counter. In this way the feeding cables are not critical to capacity and may be any convenient length. An alarm system is connected to the circuit output and can be set to give a warning at any rate up to about 40,000 c/m. A selector switch can be used to connect all five counters in parallel as a general warning system or to connect any single counter at a time to determine the radiation level at a particular location. Brass shields are provided for the counters so the β activity can be shielded out if desired.

Some comparison tests have been made of several survey instruments in use here. The following table lists some of this data:

SURVEY INSTRUMENT COMPARISON TABLE

	Feinberg	Victoreen A	Victoreen B	Paint Pail	Pluto	Landsverk	Lauritsen
Calibration (Linearity)	Linear Scale card not marked correctly	Non-linear scale. Card 50% low	Non-linear scale. Card 20% low	Linear for intensities <1500 mr/hr card correct	Non-linear scale	Fairly linear scale	Fairly linear scale up to 500 mr/hr.
Scale (division (length	25 2 in	irregular 1-1/2 in	irregular 1-1/2 in	50 2-1/2 in	50 2-1/2 in	40 microscope	100 microscope
Range(full scale mr/hr	0-25-100	0-200	0-40	0-20	20,000c/m	0-200-2000	0-1000
Size (inches	10x6½x11½	13x3-3/4x10	13x3-3/4x10	9dia.x20L	10-3/4x5-3/4 x5-1/2	6½x3-3/4x8	13-3/4x3-7/16 x8-3/4
Weight (lbs	11# 9 oz	12# 6 oz	12# 6 oz	10# 14 oz	7# 12 oz.	5#	7# 12 oz.
Chambers(dia X ht)	6" x 6"	3" x 6"	3" x 6"	9" x 9"	3⅜"x5"xl½"	3" xl⅓"	2-1/4" x 3"
Response time (up scale (down scale	 8 sec. 8 sec.	 4 sec. 4 sec.	 6 sec. 13 sec.	 10 sec. 20 sec.	 2.5 sec. 3 sec.	 - -	 - -
Warm up time	8 min.	15 min.	15 min.	20 sec.	30 min.	0	0
Radiation measured	γ& hard β	γ& hard β	γ& hard β	γ	α (β.γ)	γ, β	γ, β
Microphonic	Yes	No	No	No	Yes	Yes	No
Geotropic	Yes	No	No	No	No	Yes	Slightly
Drift(% of full scale/min)	+.31%	+.023%	-111%	-.016%	-.12%	-	-
Battery Replacement	8 min.	40 sec.	40 sec.	8 min.	8 min.	5 min.	2 min.
General Opinion	Not rugged	Poor scale	Poor scale slow for scanning	Good sensitivity slow for scanning	Zero set unprotected	Compact	Rugged Dependable

8. Comparative Test of Sneezy and Precipitrons (T. W. Bloss)

Because of the desirability of determining the best instrument available for product counting and because some persons have ruled out the precipitrons as unsuitable from the start, it was considered wise to make a few tests. Sneezy and a precipitron were run simultaneously for 30 minute periods in the East hood of Room 59, Bldg. 706A, with the results as indicated below.

Collector	Time Between Collector And count	Flow cu.ft./min	Counts per Minute	μcuries Per cc.
Precipitron	116 h.45min	11.5	182	2.66×10^{-11}
Sneezy Filter #2	116h.45min.	3.34	21	1.06×10^{-11}
Precipitron	20 h.30min.	11.5	68	9.95×10^{-12}
Sneezy Filter #1	20 h.30min.	3.34	51	2.57×10^{-11}
Sneezy Filter #5	20 h.30min.	3.34	4	2.02×10^{-12}
Precipitron	41h.30min	11.5	72	1.05×10^{-11}
Sneezy Filter #2	41h.30min.	3.34	10	5.04×10^{-12}

In the next test the head of Sneezy was placed in front of and in series with a precipitron. A Wattman filter #50 was used for all of these tests. This series arrangement was operated at various rates of flow. At the same time a single precipitron was run as a separate check. The results of this experiment are as follows:

Flow cu.ft per min.	Collector	Time between collection and count	Count per min	Time between collection and count,	Count per min.	μcuries of all activity per cc.air	μgms product per cc.air
3.0	Precipitron	100 min.	251	56 h 5 min	4	2.2×10^{-12}	0
3.0	Filter #50	170	27	56 h 10 min	1	5.6×10^{-13}	2.8×10^{-12}
3.0	Precipitron after filter #50	185	34	56 h 15 min	2	1.2×10^{-12}	1.0×10^{-11}
2.5	Precipitron	190	58	55 h 35 min	9	6.1×10^{-12}	8.2×10^{-11}
2.5	Filter #50	175	16	55 h 40 min	1	6.7×10^{-13}	6.2×10^{-12}
2.5	Precipitron after filter #50	180	27	55 h 45 min	2	1.3×10^{-12}	1.4×10^{-11}

Table cont'd

Flow cu.ft per min.	Collector	Time between colletion and count	Count per min.	Time between collection and count	Count per min.	μcuries of all activity per cc. air	μ gms product per cc.air
2.0	Precipitron	155	43	55 h 10 min	4	3.4×10^{-12}	3.8×10^{-11}
2.0	Filter#50	170	12	55 h 15 min	2	1.7×10^{-12}	2.3×10^{-11}
2.0	Precipitron after filter #50	165	25	55 h 30 min	2	1.7×10^{-12}	1.8×10^{-11}
1.5	Precipitron			55 h 40 min	4	4.5×10^{-12}	
1.5	Filter #50			55 h 45 min	0	0	
1.5	Precipitron after filter #50			55 h 50 min	1	1.12×10^{-12}	
1.0	Precipitron			53 h 10 min	6	1.0×10^{-11}	
1.0	Filter #50			53 h 15 min	0	0	
1.0	Precipitron after filter #50			53 h 20 min	0	0	
0.5	Precipitron			52 h 35 min	3	1.0×10^{-11}	
0.5	Filter #50			52 h 40 min	4	1.3×10^{-11}	
0.5	Precipitron after filter #50			52 h 45 min	0	0	

These preliminary experiments indicate that the precipitrons used have greater collection efficiency than Sneezy. If Sneezy was 100% efficient, the precipitron behind it would not collect anything. In any case, if one wishes to count the product activity it is necessary to correct for the 10.6 hour thoron decay products by taking two readings or by waiting several days to count the sample. The 26.8 min. radon decay products are usually negligible after a few hours.

9. Product Measurements (T. W. Bloss and J. W. Morris)

The determination of product in the air by its activity in certain areas of the plant has been considered of paramount importance since the tolerance level was set at 5×10^{-10} gm/cc (Parker, CH-1433 (A2278)). At present four men are devoting full time to these measurements.

During the past month the following places were found by precipitron measurements to be above tolerance:

Bldg. 706A - Room 54 -	East Hood		1.59×10^{-8} μgm/cc
	Outside East Hood next day		1.42×10^{-10} μgm/cc
	West Hood		6.99×10^{-10} μgm/cc
	Outside West Hood		1.61×10^{-10} μgm/cc
	North Hood		7.27×10^{-10} μgm/cc
Semi-works -	Cell #4		4.55×10^{-8} μgm/cc
	Outside Cell #4		9.55×10^{-11} μgm/cc
	Cell #3		1.09×10^{-9} μgm/cc
	Outside Cell #3		8.39×10^{-11} μgm/cc
Room 15 -	South Hood		1.49×10^{-9}
	Outside South Hood next day		7.68×10^{-11} μgm/cc
Bldg. 105 - Room 201	Southwest Hood		1.39×10^{-9} μgm/cc with fan off 1.39×10^{-11} μgm/cc with fan on

The activity varied considerably from time to time in the above locations. Most measurements in product working areas indicated an activity of about 10^{-11} μgm/cc. The α count due to radon and thoron products was subtracted from the total count in all measurements. The correction was accomplished by taking an α count a few hours after collection (after the radon products are negligible) and repeating the α count the next day. The contribution of the product is given by the equation -

$$a = \frac{y_2 - y_1 e^{-\lambda t}}{e^{-\lambda t}}$$

in which a = c/m due to product.

y_1 and y_2 are the first and second countings, t is the time between countins in hours, λ is the decay constant for thoron products and = .0655 hrs^{-1}

10. Surveys

The radiographing and regrouting of the area around the experimental holes in the pile is continuing. In most cases a single regrouting seems to fill up the cavities sufficiently.

On August 1st a quantity of Cellemite was blown out of the 115 stack. This material was scattered over a considerable area and had a high activity. Decay curves indicated active isotopes of half-lifes of about 1-1/2 and 16 hours.

Continued surveys revealed most working areas are at a safe level below tolerance. The most common defect revealed this month by the laboratory surveys was the lack of proper shielding about hoods and other working areas. There were several hot spills but they were cleaned up properly.

11. Atmospheric Radiation (J. S. Cheka, S. Block)

Measurements with the X-22 β and γ chambers are continuing on a routine basis. On several occasions an increase in air activity to about double normal background has been detected at a given location with portable counters. This was for short intervals during the chemical stack discharge. However, most of the activity as measured with the X-22 chambers is associated with pile stack discharge. This is what one would expect since the 24 hour Xenon-Iodine ionization from the chemical stack is negligible compared to the argon ionization of the pile stack (differs by a factor of 275).

An analysis of the X-22 data for the past two months indicates that the atmospheric activity has shown a continued increase. During this period the operations in the chemical extraction area have increased about 10% and in 105 about 60%. The higher activities followed definitely a position correlation with the wind direction but not with wind flow. Over the range at which measurements were made, i.e. about 1-1/4 mile, it seems that the radiation is more dependent on the elevation than on the distance from the stacks. The highest readings were at the highest stations with the exception of one station at the base of the stacks, which gave the highest values of them all. The average mr/week per station for the indicated time intervals is given in the following table.

Time	Average mr/week/station	Range of Power	Total Energy of Pile
6/12 - 6/17	.180	1 - 1.06	1
6/19 - 6/24	.225	1.03 - 1.06	1.04
6/26 - 7/1	.258	1.06	1.02
7/3 - 7/8	.318	1.06 - 1.15	1.13
7/10 - 7/15	.309	1.05 - 1.18	1.26
7/17 - 7/22	.316	1.12 - 1.59	1.14
7/24 - 7/29	.343	1.62 - 1.82	1.55

Another interesting observation is that the radiation is consistantly greater during the day than the night. For example, one typical station during June gave an average reading of .0051 mr/hr during the day and .0035 mr/hr during the night.

12. Water Surveys (D. J. Rendell)

The β and γ activity of the holding pond effluent continues at a safe level of about 4 mr/hr. The water in White Oak Lake is about background.

A new difficulty has developed. An algae which seems to have a selective absorption for some of the active products is collecting on the surface of the holding pond, White Oak Lake and below the lake. The following readings were made with a Laurítsen placed on the ground at the four corners of the holding pond near the edge of the water:

Date	NW	NE	SE	SW
8/23/44	63 mr/hr	23 mr/hr	15	7
8/24/44	46	22	40	50
8/25/44	22	75	-	90
8/26/44	101	15	28	102

It was observed in every case that the high readings occurred when the algae was close at hand, and was a function of wind direction. Firemen have been beating the algae down with water from a fire hose. Two algae samples were collected from the overflow of White Oak Lake. They were checked with a β counter and found to contain 2.93×10^{-3} μc/gm dry weight and 3.42×10^{-3} μc/gm respectively.

At present there is a large amount of this hot algae washing down into the Clinch River system. Steps are being taken to try to kill this algae or to fish it from the water. A boat has been secured which is aiding in collecting samples from White Oak Lake. It is expected that this boat will be used in cleaning out the overflow screens and removing the algae from White Oak Lake.

13. Mud Samples (D. J. Rendell and S. Farmakes)

The activity of the mud in the White Oak system has increased continually. It is difficult to make a good comparison of data because there is often considerable variation in activity of samples from the same location. However, the following table points out the general trend:

Activity in μcuries/gm.

Location	6/19	7/4	7/26	8/22
Upper end of small pond near south gate	1.2×10^{-4}	2.9×10^{-3}		2.7×10^{-2}
Upper end of dyke pond	3.1×10^{-3}	4.3×10^{-3}		1.2×10^{-2}
Lower end of dyke pond	4×10^{-4}	4.7×10^{-2}	2.6×10^{-2}	5.6×10^{-2}
Upper end of White Oak Lake		1.0×10^{-4}	6.4×10^{-4}	
Near overflow from White Oak Lake	4.4×10^{-5}			3×10^{-3}
Just below White Oak Lake	4.5×10^{-6}	4.7×10^{-6}	4.2×10^{-5}	2.3×10^{-4}

14. Training Program (C. M. Patterson)

A new training program is underway to train 15 new Hanford trainees and nine new S.E.D. men. The S.E.D. men are replacements for some of the personnel lost last month.

15. Work for the coming month.

Routine work will consist of the following:

(a) Surveys in all areas
(b) Meteorological surveys
(c) Water, mud and algae surveys
(d) Pocket and badge meter service
(e) Hand and glove counting
(f) Laundry monitoring
(g) Product surveys
(h) Calibration of all health physics instruments every 2 weeks.

New instruments are being developed and will be tested.

The training program will be continued.

Calibration work will be done on the new ≺ emulsion film.

CLINTON LABORATORIES

III. BIOLOGICAL SECTION OF RESEARCH DIVISION

Report by H. J. Curtis
Section Chief

1. Biological Effects of Pile Radiations - R. E. Zirkle, J. R. Raper, E. F. Riley, G. Stapleton

A. New Equipment. The air conditioned room enclosing the entrances to the exposure tunnels was completed about the middle of August and has been in satisfactory operation since that time.

B. Effects of Single Doses of Slow Neutrons on Mice (142-X11B). Several groups of mice have been exposed to graded doses which have been measured in an arbitrary fashion by means of a boron-sheathed Victoreen r-meter which is attached to the top of the bismuth carriage in a standard position and which gives readings proportional to kilowatt-hours within the range of power levels recently available. The status of these animals is as follows:

Date of Exposure	Dose (Arbitrary Units)	No. of Mice	Sex	Survivors 8-29-44	Percentage 3-week Surv.
7-31-44	134	23	F	23	100
8-3-44	193	24	F	24	100
8-7-44	256	23	F	19	83
8-15-44 8-16-44	199 218 } 417	24	F	15	Not more than 63. (Only 2 weeks elapsed.)

It is evident that the partially lethal range has been approximately located. The effectiveness of the last dose--417 arbitrary units--probably was decreased by delivering it in two portions on successive days.

Several graphite ionization chambers of the concentric-spheres type designed by H. M. Parker have been completed. After calibration and testing, these will be used to determine the doses of capture gamma radiation absorbed in the animal body which correspond to the arbitrary doses tabulated above. Measurements of slow neutron flux at the position of the animals will also be carried out. Preliminary estimates indicate that one arbitrary unit corresponds to 3.5×10^{10} neutrons per cm^2. The average time required to deliver one unit is about one minute.

C. Effects of Small Periodic Doses of Fast Neutrons on Mice (142-X13B). Periodic exposure of the groups of animals tabulated in the last monthly report (CH-1862, p. 15) have been continued, and several

TABLE I

Periodic Exposures of Mice to
Fast Neutrons

Entry	Dose	Strain	Sex	Irrad. Animals-(XC-)	Specific Controls-(XC-)	Date Begun	Doses to 8-29	Total Dose to 8-29 (n)	Orig. No.	Survivors Irrad.	Survivors Cont.	Remarks
1	1.15n/day	CF_1	F	52643-68	52721-46	6-27-44	45	51.7	26	25	24	
2	"	"	F	52669-94	"	6-27-44	45	51.7	26	23	24	
3	"	"	F	52903-27	52928-52	7-3-44	41	47.1	25	19	25	
4	"	"	F	53078-102	53103-27	7-7-44	37	42.5	25	25	23	Growth apparently slightly retarded
5	"	"	M	52953-77	53003-27	7-4-44	40	46	25	22	22	
6	"	"	M	52825-50	52851-76	7-4-44	40	46	26	26	26	
7	"	"	M	53257-81	53282-306	7-8-44	37	42.5	25	14	21	
18	"	"	M	53568-86	53587-605	8-12-44	14	16.1	19	18	19	
8	4.3n/day	CF_1	F	52695-720	52721-46	6-27-44	46	198	26	26	24	Growth apparently retarded
9	"	"	F	52773-98	52799-824	7-4-44	40	172	26	4	25	Growth apparently retarded
10	"	"	F	53053-77	53103-27	7-7-44	38	163.5	25	23	23	Growth apparently retarded
11	"	"	F	53128-53	53154-79	7-7-44	38	163.5	26	23	26	
12	"	"	M	52978-3002	53003-27	7-4-44	41	176	25	24	22	
13	"	"	M	53232-56	53282-306	7-8-44	37	159	25	21	21	Growth apparently retarded
14	"	"	M	53180-205	53206-31	7-24-44	28	120.5	25	22	23	
19	"	"	M	53254-79	53280-305	8-5-44	18	77.5	26	26	25	Growth apparently retarded
20	12.9n/day	CF_1	F	53658-83	53606-31	8-21-44	7	90	26	26	22	
21	"	"	F	53684-709	53632-57	8-21-44	7	90	26	26	26	
15	Gen. Control	CF_1	F		52747-72	6-27-44	---		26	26		
22		"	F		53542-67	8-9-44			26	24		
16		"	M		52877-902	7-1-44			26	26		
17		"	M		53008-52	7-4-44			25	24		

other groups have been initiated. The status of all animals as of 8-28-44 is summarized in Table I. It will be noted that high mortality has occurred in one group receiving 4.3 n per day (Entry 9) and considerable mortality in one group receiving 1.15 n per day (Entry 3). Moreover, several groups are gaining weight more slowly than their controls.

D. Delayed Effects of Single Doses of Fast Neutrons on Mice (142-X15B). Two groups have been exposed to date:

Dose (n)	Strain	Sex	Animal Nos. Irradiated	(XC-) Control	Date Irrad.
26	CF_1	F	53354-77	53378-401	8-5-44
26	CF_1	M	53422-41	53402-21	8-5-44

No effects have been detected to date.

2. Biological Effects of External Beta Rays (246-X7B). J. R. Raper, R. E. Zirkle

A. Sources. Five phosphorus-impregnated plastic samples were received from Virginia Lincoln Corp. on August 3. These samples consisted of 50% Phosphorus (by weight) embedded in phenol-formaldehyde resin. Portions of these samples were bombarded in the pile for 15 MWD without apparent damage to the mechanical properties of the material. A week's cooling period was necessary before the material could be handled. An extrapolation chamber measurement of beta ray intensity at the surface of a 3" square plaque was made on the 15th day after removal from the pile. The measured surface intensity at this time was 3300 r/hr. The operation temperature of the pile has again been increased, however, to the point that it appears probable that this material can be used only if cooled during activation.

B. Exposures. A group of some thirty rabbits are now being exposed to doses ranging from 3000 to 15000 r (measured at the skin surface). These animals will make possible a repetition and an extension of the macroscopic observations made earlier on a small group of rabbits, most of which were lost in the heat accident of 6-18-44. Moreover, some of them will be sacrificed periodically for histological examination of the skin.

3. Biological Monitoring (142-X3B) - Elizabeth Anderson

Shelters for the monitoring animals have been built around the grounds and the animals replaced. Also, an air conditioned room has been built on the 3rd balcony on the south face of the pile, and the pile monitoring animals have been placed in this.

4. Metabolism of Short-lived Fission Products (244-X1B) - H. Lanz, J. Teresi

A new ionization chamber and electrostatic precipitator have been installed in the gas line from the fission recoil apparatus which should give a more accurate picture of the activity to which the animals are exposed.

Data are now complete up to 31 days on rats exposed for 5 hours to gas with a delay time of 1.2 sec. (75 μC/cc). This data is given in Table 2. It will be noticed that even after 31 days the highest specific activity is still in the lungs, whereas about half of the activity remaining in the body is in the skeleton. The external body irradiation which these animals received during the course of the exposure amounted to about 75 r of γ rays and 100 r of β rays. The animals were confined in a cellulose acetate cone during the exposure, so they must have received very little activity by licking.

It is interesting to note that even though these animals were subjected to high concentrations of activity (75 μC/cc), the amount of activity deposited in the body was lower by about a factor of 3 than when animals were exposed to lower concentrations (23 μC/cc). This apparent anomaly is due to the fact that the activity is increased by increasing the flow rate which decreases the holdup time and brings in a higher percentage of short-lived fission products. This means that the long-lived isotopes are being diluted, and since these are the ones which are being measured in these experiments, their concentration and therefore the total amount deposited will decrease as the measured activity increases.

TABLE II

Activity found in various organs at various times following a 5 hour exposure to the fission recoil gas of approximately 75 μC/cc, hold-up time 1.2 sec. 175 g. female rats; one animal for period; measurements made with mica-window GM counter.

Percentage of Total Absorbed Activity

Tissue	0 hrs. μC/gm	0 hrs. % per organ	48 hrs. μC/gm	48 hrs. % per organ	72 hrs. μC/gm	72 hrs. % per organ	31 days μC/gm	31 days % per organ
Thyroid	—	1.02	--	3.9	—	2.5	—	1.73
Lungs	3.9	19.3	1.48	6.3	1.03	5.8	.59	2.94
Liver	.17	6.2	.21	6.0	.14	5.8	.078	2.27
Stomach	.115	1.9						
Cecum	.106	1.9	.029	2.7	.013	1.6	.016	0.87
S. & L. Intest.	.11	4.1						
Kidneys	.20	1.6	—	--	—	—	—	--
Femur & Tibia	.201	1.0	.425	1.4	.31	1.5	.294	1.94
*Skeleton	.201	13.7	.43	26.0	.31	23.0	.294	21.0
Rest of Carcass	.08	50.0	.02	10.0	.026	16.5	.0144	8.5
Total Excreted	—	0	—	43.5	—	43.9	--	61.0
Total		100		100.2		100.2		100.25
Total μC		23.3		23.7		20.6		24.2

*Activity was obtained by multiplying the activity of 1 gm of femur and tibia by the total weight of Skeleton. It was assumed that bone comprises 10% of the total body weight.

5. Metabolism of Fission Products (246-X2B) - W. E. Cohn, E. R. Tompkins, G. Parker, J. X. Khym, S. Weiss

A. Remote control ether extractor for hot laboratory - E. R. Tompkins, G. Parker, S. Weiss

The completion and testing of the first stage extractor (U reduction factor 50 to 500: "semi-juice") was reported last month. This month saw the installation and testing of the second stage (U reduction factor through both stages 10^5 to 10^7: "super-juice"). Bothe tages are now going into routine production of both "semi-juice" and "super-juice" from slugs dissolved in the new all-glass dissolver. It is visualized that ether extraction through one or both stages will routinely precede all hot chemical operations as a volume reduction step, so that volumes of more than a few hundred ml will not be encountered.

B. Adsorption columns as F.P. separators - E. R. Tompkins, J. X. Khym, W. E. Cohn

Further experiments with ammonium salts of tartaric acid have shown that Yttrium may be quantitatively separated from Cerium after adsorption on IR-1 resin, and that these may be separated from Strontium and Barium when all four are present at one time. Present indications are that the latter two may also be separated. The major discovery has been that slight variations in pH of the ammonium tartrate are the decisive factors. Adding NH_4OH to tartaric in a molar ratio of 1:2 (pH=2.7) gives a solution which selectively elutes Y. If the ratio is increased to 1.5:2 (pH=2.85) both Y and Ce are removed, while a ratio of 2:2 (pH=3.1) removes Y, Ce and Sr, but not Ba. All tartrate solutions used have been nearly saturated. The use of oxalic acid for Zr and Cb, and of HCl for Ba, have been reported.

Combining this knowledge with previous information, we have now the possibility of using adsorption columns to separate the following fission products in pure radiochemical form from an adsorbed fission mixture: Zr plus Cb, Y, Ce, Sr, Ba. If super-juice is used as the starting material, there is the possibility of recovering Ru also, and perhaps Te and I.

Experiments are still in progress to evaluate the following:

1. Strength of salt or acid and pH vs. specificity.
2. Type of acid (tartaric, citric, malonic, oxaloacetic, etc.) vs. specificity.
3. The column as a volume reduction step in f.p. separation.
4. The column as a method of removing undesirable impurities from pure fission species (e.g. tartrate from Y, Ce or Sr preparations).
5. The behavior of Ru, Te and I in the process.

We believe that it is possible, by judicious choice of reagents, to eliminate entirely the necessity of "hot" chemistry in f.p. preparations, with its attendant exposure hazard.

C. The following radioactive materials have been shipped out this month:

Sulfur (p^{32}): 2 shipments of 0.6 and 1.0 C, respectively, to Radiation Lab.
Yttrium: 1 shipment of about mC to Metallurgical Lab. (K. S. Cole)
Mixed Y and Ce: 1 shipment of about 200 mC to Metallurgical Lab. (K. S. Cole)
Ru: 1 shipment of about 5 mC to Metallurgical Lab. (K. S. Cole)
I: 1 shipment of a slug to Metallurgical Lab. (K. S. Cole) (for I separation)
P: 2 shipments of 45 mC each to Metallurgical Lab. (K. S. Cole)

6. Work for the Coming Month

Acute exposures to slow neutrons should be completed and several chronic series should be started. The fast neutron chronic exposures will be continued and enlarged. New apparatus will be built for chronic exposures to gamma rays, since present sources are not sufficiently pure.

It is still to be hoped that satisfactory beta ray sources can be developed soon. However, existing sources will allow some exposures to be made.

Work will continue on the metabolism of air-born fission products, and it is hoped that a few chronic series can be started. In addition, work will continue on the purely respiratory phase of the problem.

The research work of the separations group will be directed chiefly to the development of adsorption columns, since this method looks so promising now.